JP2003-018600 MACHINE TRANSLATION

PATENT ABSTRACTS OF JAPAN

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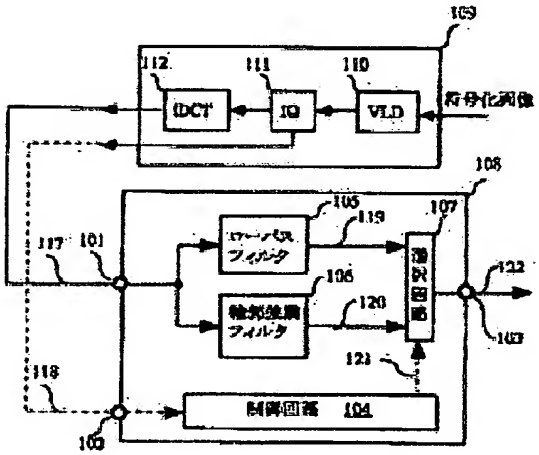
(54) IMAGE DECODING APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To solve the problems where, in a conventional MPEG image decoding apparatus, a low-pass filter may act even on the part which requires no noise removal because filtering is controlled based on a motion information for high quantization precision, and the block distortion is promoted by quantization error to degrade image quality if an edge enhancement filter is used.
SOLUTION: While predicting appearance of block distortion and mosquitos with the use of the quantization information at encoding, a low-pass filter or an edge enhancement filter is appropriately selected to act on a decoded image, to raise quality of an output image.



CLAIMS

[Claim(s)]
[Claim 1]In an image decoding device which decodes a picture signal compressed by an image coding system, An image decoding device changing the first filter of the above, and the second filter, and making them act to a decoded image based on quantization information which consisted of the first filter and second filter and was performed at the time of coding.
[Claim 2]With a filter which emphasizes a contour part of a picture, constitute said first filter from a low pass filter, constitute said second filter, and as said quantization information, A quantizing scale which codes a DCT coefficient in image coding of an MPEG standard is used, When larger than a set-up value with a quantizing scale, said first low pass filter is made to act, An image decoding device of Claim 1 outputting a decoded image which made said second filter act when small, reduced block distortion generated in a decoded image, and emphasized an outline of an image.
[Claim 3]An image decoding device of Claim 1 with which said first filter and said second filter are characterized by making variable respectively the filter factor and tap numbers, and changing a filter factor and a tap coefficient based on quantization information.
[Claim 4]While a low pass filter or a median filter aiming at removing block distortion as said first filter is used, A filter for emphasizing an outline as said second filter is used, An image decoding device of Claim 1, wherein, as for said second filter, whether it acts performs [on which said first filter acts based on quantization information at the time of coding / or or] filtering to an outputted image of said first filter by being determined.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is applied to the decoding device of the picture signal compressed by image coding systems, such as MPEG, and relates to effective technology.
[0002]
[Description of the Prior Art]In the conventional image decoding device, in order to reduce the noise contained in an outputted image, it is common to use a low pass filter. For example, in image coding systems, such as MPEG, when a motion of a picture is large, encoding efficiency gets worse. For this reason, in order to reduce the code amount to generate and to quantize roughly at the time of coding, In order that the thing which is a unit of coding as a result and which distortion generates for every block may reduce the image deterioration by this block distortion that often exists (it is called block distortion below.), When the movement quantity of an image is large, a low pass filter is applied to a decoded image, and the technique of removing such block distortion is generally known well.
[0003]
[Problem to be solved by the invention]In the removing method of the block distortion by the

conventional low pass filter, since the low pass filter is applied per image frame, a low pass filter will be applied also to the portion which block distortion has not generated, and there is a problem that the whole picture fades.

[0004]Since it generates [block distortion] in many cases when quantization precision at the time of coding is low, if quantization precision is high, even if movement quantity is large, it will become difficult to generate block distortion. However, in a block distortion removing method by a low pass filter which is conventional method, since only motion information which is difference information with a front picture is referred to, also when quantization precision at the time of coding is high, a low pass filter is applied and there is a problem that the whole picture fades.

[0005]Since recognition of the picture as which an outline is generally emphasized "is made into a good picture" rather than a picture from which an outline fell is carried out, it needs to emphasize an outline in a picture. However, in conventional method, in order to apply a low pass filter for removing block distortion, while a contour part of a picture is also referred to as fading simultaneously, there is a title.

[0006]The purpose of this invention prevents an outline of a picture from fading while reducing block distortion generated when a large quantization step is taken, in order to reduce a code amount to a big picture of a motion, and it provides an image decoding device which can raise display image quality. About the other purposes and the new feature, it will become clear from description and an accompanying drawing of this Description along [said] this invention.

[0007]

[Means for solving problem]It will be as follows if an outline of a typical thing is explained among invention indicated in an application concerned. That is, in this invention, filtering using a quantization parameter as a control signal is performed in the latter part of a decoder. That is, an operation of a low pass filter was controlled not using motion information but using quantization information at the time of coding so that a low pass filter acted only to a portion which block distortion has generated. In order to emphasize a contour part of an inputted image to a portion in which block distortion does not exist, a filter (the following, edge enhancement filter) which emphasizes a contour part is made to act.

[0008]It is made to act on an image by providing a low pass filter and an edge enhancement filter in an outputting part of a decoded image, and changing suitably this low pass filter and edge enhancement filter as these concrete realization techniques, using quantization information at the time of coding.

[0009]As composition into which this technique was developed, using a block distortion removal filter by quantization information, etc., before performing edge enhancement, block distortion is removed, it is making an edge enhancement filter act over the whole picture after that, and edge enhancement which controlled a noise is performed.

[0010]

[Mode for carrying out the invention]Hereafter, a suitable embodiment of this invention is described based on Drawings. Drawing 1 is one embodiment **** of an image decoding device

of this invention. The image-filters equipment 108 of this example The decoded image input terminal 101, It comprises the quantization parameter input terminal 102, the processing generating picture terminal 103, the control device 104, the low pass filter 105, the edge enhancement filter 106, and the selection circuitry 107, and let the decoded image 117 which the decoder 109 outputted be an inputted image.

[0011]The decoder 109 comprises the variable length decoder (VLD) 110, the inverse quantization device (IQ) 111, and the reverse discrete cosine transform machine (IDCT) 112, with this decoder 109, decoding processing of the input coded image 113 is carried out, and it outputs the decoded image 117. Simultaneously, a table of a quantization parameter used from the inverse quantization device 111 on the occasion of inverse quantization is given to the control circuit 104 as the quantization parameter signal 118. The image-filters equipment 108 of this embodiment is constituted by the selection circuitry 107 which chooses a picture processed with the low pass filter 105, the edge enhancement filter 106, and one of filters, and the control circuit 104 which controls said selection circuitry 107 based on a quantization parameter value.

[0012]The decoded image signal 117 inputted into the decoded image input terminal 101 is inputted into both the low pass filter 105 and the edge enhancement filter 106. Simultaneously with it, the control circuit 104 the quantization parameter signal 118 of the decoded image to origin. The control signal 121 is sent to the control circuit 107, when a quantization parameter value is large, the low pass filter output signal 119 is chosen, when a quantization parameter value is small, the edge enhancement filter output signal 120 is chosen, and it outputs as the output image signal 122 from the output terminal 103.

[0013]The feature of an image decoding device of this example is in the image-filters equipment 108. Hereafter, this image-filters device part is explained. Drawing 5 is an example of a low pass filter. This low pass filter is a filter of three taps, and it comprises the two delay circuits 501 and product sum operation machines, and the input pixel 504 is inputted into the delay circuit 501, respectively, and is delayed. And to each output of the delay circuit 501, the tap coefficient 502 is made to act, it adds, finally equalizing processing 503 is performed, and the output picture elements 505 are obtained. A low-frequency component is passed by a filter of this example giving twice as many dignity as this to a main pixel value to the next pixel value, and applying one fourth.

[0014]Drawing 6 is an example of a highpass filter which is needed in an edge enhancement filter. Like drawing 5, it is a filter of three taps, and it comprises the two delay circuits 601 and product sum operation machines, and the input pixel 604 is inputted into the delay circuit 601, and is delayed. The tap coefficient value 602 of a filter of this example is taking difference with the next pixel, and passes only a high frequency component.

[0015]Drawing 7 shows an example of composition of the edge enhancement filter 708 using a highpass filter of drawing 6. The edge enhancement filter 708 of this embodiment is realizable by making the highpass filter 706 act to the inputted image 704, adding an outline which is an output with an adding machine to the original inputted image 704 like drawing 7, and obtaining the outputted image 705. In order to realize an edge enhancement filter of this example by three

taps like a low pass filter, the tap coefficient 702 is set up like drawing 7. Since this 3 tap edge enhancement filter circuit comprises the delay circuit 701 and the tap coefficient 702 and it is constituted by the sum of a highpass filter which passes an ingredient of a high frequency region of a picture, and the original pixel value, Edge enhancement is realized by making into the output picture elements 705 what added a high pass ingredient to the input pixel 704.

[0016]Drawing 2 shows one of the embodiments of image-filters equipment in an image decoding device of drawing 1, and this image-filters equipment 208, It comprises the decoded image input terminal 201, the quantization parameter input terminal 202, the processing generating picture terminal 203, the control device 104, the block distortion removal filter 205, the edge enhancement filter 106, and the selection circuitry 107.

[0017]The decoded image signal 217 which the quantization parameter signal 218 inputted into the quantization parameter input terminal 202 was inputted into the control circuit 104, and was inputted from the signal decoded image input terminal 201 is first inputted into the block distortion removal filter 205. A control circuit outputs the selection time control signal 221 with a quantization parameter value, and after choosing either the block distortion removal filter output signal 219 or the decoded image signal 217 by this and emphasizing an outline with the edge enhancement filter 106, it outputs as the output image signal 222.

[0018]In drawing 1, to the low pass filter 205 and the edge enhancement filter 106 having been chosen, before performing edge enhancement by this technique, the cause of the noise is beforehand removed with the block distortion removal filter 205, and in order to perform edge enhancement after that, it becomes possible to always perform edge enhancement. A quantization parameter performs control of the block distortion removal filter 205 and the edge enhancement filter 106 like the case of drawing 1.

[0019]As stated above, in this example, constitute the 1st filter from a one-dimensional low pass filter, and constitute the 2nd filter from a one-dimensional edge enhancement filter, but. It can guess easily from the above-mentioned embodiment that a two-dimensional filter or a noise reducer can use other filters as these filters, and the improvement of image quality can be aimed at by controlling using a quantization parameter value also to those filters.

[0020]Image-filters equipment of drawing 3 is a developed type of the technique of drawing 1, and this image-filters equipment 308, The decoded image input terminal 301, the quantization parameter input terminal 302, and the processing generating picture terminal 303, It comprises the control device 104, the low pass filter 305, the edge enhancement filter 306, the selection circuitry 107, the edge enhancement filter table 309, and the low pass filter table 310.

[0021]This filter table a tap coefficient of the low pass filter 105 with a form as shown by drawing 6 on the low pass filter table 310. It has a tap coefficient of the edge enhancement filter 306 in the edge enhancement filter table 309 every partly, respectively, and it has been the greatest feature to choose a tap coefficient value of each filter with a value of a quantization parameter. The decoded image signal 317 inputted into the input terminal 301 is inputted into the low pass filter 105 and the edge enhancement filter 106.

[0022]The quantization parameter signal 318 is inputted into the control circuit 104 from the

quantization parameter input terminal 302. The edge enhancement filter table control signal 323 and the low pass filter table control signal 324 are outputted by this quantization parameter value to the edge enhancement filter table 309 and the low pass filter table 310, respectively. And the edge enhancement filter tap coefficient 325 and the low pass filter tap coefficient 326 are passed to each filter circuit by this control signal. With the selection-circuitry control signal 321 from the control circuit 104, the control circuit 107 chooses one of the low pass filter output signal 319 and the edge enhancement filter output signals 320, and makes it the output image signal 322.
[0023]An example of composition of a filter for changing a tap coefficient value of a low pass filter with a quantization parameter value is shown in drawing 8. A filter of drawing 8 is a lowpass filter circuit of five taps which comprise the delay circuit 801, the tap coefficient multiplier 802, the equalization coefficient multiplication machine 803, and the filter table 806.
[0024]In this filter, after each delay value of the input pixel signal 804 is processed with a tap coefficient and is finally altogether added with the multiplier 802 formed in each tap, it is equalized with the equalization multiplier 803 and becomes the outputted image 805. Two tap coefficient groups were shown in the filter table 806 as an example. Rather than a case of a left-hand side coefficient group, since a zone of a filter serves as the narrow characteristic, a right-hand side coefficient group passes only an ingredient which is a low frequency wave more. Therefore, it is possible to analyze a quantization parameter value, to choose a right-hand side coefficient, when an appearance of a noise is expected, and to choose a left-hand side coefficient, in being other.
[0025]An embodiment of a highpass filter which is a variable tap coefficient used for an edge enhancement filter is shown in drawing 9. An edge enhancement filter circuit of this embodiment is an edge enhancement filter circuit of five taps which comprise the delay circuit 901, the tap coefficient multiplier 902, the alpha value multiplier 903, and the filter table 906. Zone of right-hand side is narrow and, as for a tap coefficient, a zone has become widely, as for left-hand side as is shown in a filter table 906. Thus, tap numbers can be made variable by making a tap coefficient value variable.
[0026]When an outline of the whole picture is sweet, this filter table 906 is used by a picture by which an outline is solid using a tap coefficient of left-hand side which extended a zone as a coefficient group on the right-hand side of [narrow] a zone is used. Since adding a contour part to an original image has realized edge enhancement in a method shown in drawing 7, in an embodiment of drawing 9. It is being further taken into consideration how much a contour part which is an output value of not only a tap coefficient value but a highpass filter is added to an original image in analyzing a quantization parameter. It is determined here outline components of which after the input pixel value 904 is processed by each tap, the multiplication of it is carried out to the alpha value 919 with the multiplier 903, and it puts to an input pixel value. This alpha value is controlled using a quantization parameter.
[0027]Composition of drawing 4 is a developed type of the technique of drawing 2, and this image-filters equipment 408, It has the decoded image input terminal 401, the quantization parameter input terminal 402, the processing generating picture terminal 403, the control device

104, the block distortion removal filter 205, the edge enhancement filter 406, the selection circuitry 107, the edge enhancement filter table 409, and the processing generating picture terminal 403. The decoded image signal 417 inputted from the decoded image input terminal 401 is inputted into the block distortion removal filter 205.

[0028]It can come, simultaneously the quantization parameter signal 418 is inputted into the quantization parameter input terminal 402, and this signal is inputted into the control circuit 104. With the selection-circuitry control signal 421 from this control circuit 104, one of the block distortion removal filter output signal 419 and the decoded image signals 417 is chosen by the selection circuitry 107. Thus, it is possible to make the block distortion removal filter 205 act to an inputted picture, and to make the edge enhancement filter 106 in the latter part act over the whole picture by removing block distortion etc. beforehand.

[0029]The control signal 423 is outputted and controlled to the filter table 409, the tap coefficient 425 of the edge enhancement filter 406 becomes settled by this, and the control circuit 104 is passed to the edge enhancement filter 406. In this edge enhancement filter 406, after making this tap coefficient 425 act on the inputted picture, it outputs from the processing generating picture terminal 403 as the output image signal 422.

[0030]In the embodiment of drawing 4, although the block distortion removal filter 205 was used, there is a median filter as an example of a filter effective in block distortion removal. The median filter is constituted by the delay circuit 1001 and the comparator 1006 as shown in drawing 10. If the tap numbers of a filter are used as n tap, it will compare [input pixel / 1004] about all the n pixel values, and the pixel value which is the median 1007 will be outputted as the output picture elements 1005. A median filter is a filter from which only a noise component can be removed comparatively efficiently, without dropping the original outline of a picture.

[0031]There are all of the greatest feature of such filter constitution described above in being controlled by a quantization parameter. Although one picture is constituted by set of a macroblock, this quantization parameter is defined by macro block unit. As a macroblock is shown in drawing 11, four DCT blocks 1100 in the case of image compression coding gather, and a quantization parameter value is constant at 1106 units of this macroblock. This quantization parameter value has big influence on imaging quality.

[0032]DCT blocks can be divided into the dc component 1101, the low-frequency component 1102, the vertical high frequency component 1103, the horizontal high frequency component 1104, and the high frequency component 1105 as shown, for example in drawing 11. When a value of a quantization parameter of the dc component 1101 is large, in a decoded image, a quantization error becomes large, a luminance value of the whole DCT-blocks field changes per DCT blocks, and block like shape carries out an image, it is recognized, and this serves as block distortion. When a quantization parameter value in a field of the high frequency component 1105 is large, Since a noise called a mosquito comes out in order that distortion may come out to a high region, and also information on a high frequency component is missing, also becoming a cause which it becomes impossible to express a sharp contour part, and forms block distortion between contiguity blocks is generally known.

[0033]A filter device in this invention performs filtering processing in a unit of the filter block 1107 to the whole picture, when filtering, for example in the whole picture. As an example of how to treat a quantization parameter of the filter block 1107, a quantization parameter value of each pixel contained in the filter block 1107 can be asked by weighting a pixel number like drawing 11. This value Qav is expressed with following formula $Qav=(NL\text{-}NU\text{-}Q1+NR\text{-}NU\text{-}Q2+NL\text{-}ND\text{-}Q3+NR\text{-}ND\text{-}Q4)/t^2$.

[0034]if the technique of this invention is boiled and it depends, it can be guessed whether generating of a noise is predicted with this Qav value by field on which filtering processing is made to act comparatively easily and correctly. If a value of this Qav is large, a low pass filter will be made to act in the technique of drawing 1, and a block distortion removal filter will be made to act by the technique of drawing 2. Therefore, edge enhancement is performed without making a low pass filter act and dropping an outline on the macroblock 1106 with a small quantization parameter value, in the macroblock 1106 with a large quantization parameter, a low pass filter acts and reduction of a noise is performed.

[0035]Drawing 13 can be considered as an example of a block distortion removal filter which removes only block distortion. A quantization parameter value changes by a macro block unit. [for this reason, / in the filter block 1107 on which a filter is made to act], Compare the existing quantization parameter value about perpendicularity and a horizontal direction, and The maximum max (Q1, Q3), max (Q2, Q4), max (Q1, Q2), and max (Q3, Q4) are taken, When max (Q1, Q3) or max (Q2, Q4) is larger than a threshold, the low pass filter to a perpendicular direction is made to act, and when max(Q1, Q2) max (Q3, Q4) is larger than a threshold, the low pass filter to a horizontal direction is made to act. In this technique, the horizontal-blocks boundary detection range 1301 and the vertical block boundary detection range 1302 in which the value is variable are set as horizontal and vertical both directions, When the macroblock boundary 1303 does not exist in this range, a block border is not detected but it is made not to make a low pass filter act.

[0036]Drawing 14 and drawing 15 show composition of one embodiment for a circuit to realize the technique of this invention shown in drawing 1. Drawing 16 and drawing 17 show similarly an example of realization according a technique shown in drawing 2 which is an application of drawing 1 to a circuit as composition.

[0037]An example for realizing drawing 1 is drawing 14. This image-filters equipment 1408 The decoded image input terminal 1401 and the quantization parameter input terminal 1402, The processing generating picture terminal 1403, the filter control part 1404, and the low pass filter 1405, The edge enhancement filter 1406, the selection circuitry 107, and the low pass filter table 1409, The edge enhancement filter table 1410 and the timing input terminal 1411, It comprises the low pass filter control section 1412, the edge enhancement filter control section 1413, the line memory 1414 of a low pass filter, the line memory 1415 of an edge enhancement filter, and the selection-circuitry control section 1416. The line memories 1414 and 1415 are used for preservation of data for a picture of several lines in the case of filter application. The decoded image signal 1417 is inputted from the input terminal 1401, and is inputted into the low pass

filter 1405 and the edge enhancement filter 1406.
[0038]It can come, simultaneously a quantization parameter signal and the 1418 timing signals 1419 are inputted and analyzed from the input terminals 1402 and 1411 to the filter control part 1404. The low pass filter control section 1412 contained in this filter control part 1404, The low pass filter control signal 1424 and the edge enhancement filter control signal 1423 are given to the low pass filter table 1409 and the edge enhancement filter table 1410 by the edge enhancement filter control section 1413, respectively.
[0039]Thereby, the suitable tap coefficient 1426 of a low pass filter and the tap coefficient 1425 of an edge enhancement filter are passed to each filter circuit. The selection circuitry 107 is controlled by the selection-circuitry control signal 1421 from the selection-circuitry control circuit 1416, either an output of the low pass filter 1405 or an output of the edge enhancement filter 1406 is chosen, and the output image signal 1422 is outputted from the processing generating picture terminal 1403. In this circuit, since the low pass filter 1405 and the edge enhancement filter 1406 have the original memories 1414 and 1415, little operation of delay is comparatively possible.
[0040]On the other hand, it is the image-filters equipment 1508 of drawing 15 which unified a memory using a data bus. This edge enhancement filter circuit The decoded image input terminal 1501 and the quantization parameter input terminal 1502, The processing generating picture terminal 1503, the filter control part 1504, and the low pass filter 1505, The edge enhancement filter circuit 1506, the selection circuitry 107, and the low pass filter table 1509, It has edge enhancement and the filter table 1510, the timing input terminal 1511, the low pass filter control section 1512, the edge enhancement filter control section 1513, the line memory 1514, and the selection-circuitry control section 1516. The decoded image signal 1517 inputted from the input terminal 1501 is inputted into the low pass filter 105 and the edge enhancement filter 106.
[0041]The quantization parameter signal 1518 and the timing signal 1519 are inputted from the input terminals 1502 and 1511 to the filter control part 1504, and it is analyzed in the low pass filter control section 1512 and the edge enhancement filter control section 1513. From these two control sections, the low pass filter table control signal 1524 and the edge enhancement filter table control signal 1523 are given to the low pass filter table 1509 and the edge enhancement filter table 1510. As a result, the optimal low pass filter tap coefficient 1526 and the edge enhancement filter tap coefficient 1525 are given to each filter circuit.
[0042]The selection-circuitry control section 1516 outputs the selection-circuitry control signal 1512, and any one is chosen from two signals by the selection circuitry 107, and it is outputted as the output image signal 1522 from the processing generating picture terminal 1203. In this circuit, the low pass filter 1505 and the edge enhancement filter 1506 are sharing the memory 1514 via a data bus. For this reason, although circuit structure can be made comparatively smaller than a case of drawing 12, control of the whole circuit becomes a little complicated.
[0043]Next, an example of 1 realization of a circuit of drawing 2 is shown in drawing 16 and drawing 17. In drawing 16, the image-filters equipment 1608, The decoded image input terminal 1601 and the quantization bara meter input terminal 1602, The processing generating picture

terminal 1603, the filter control part 1604, and the median filter 1605, The edge enhancement filter circuit 1606 and the edge enhancement filter table 409, It has the median filter control section 1609, the edge enhancement filter control section 1610, the timing input terminal 1611, the line memory 1612, and the line memory 1613, and the median filter 1605 is used as the block distortion removal filter 205.

[0044]The decoded image signal 1617 is inputted into the input terminal 1601 in drawing 16, The image data is inputted into the median filter 1605, and removes block distortion and a mosquito noise beforehand, The edge enhancement filter 206 is made to act after that, it has become circuitry which outputs the output image signal 1622, and a median filter is controlled by median filter system ****** 1624 from the median filter control section 1609.

[0045]The edge enhancement filter table control signal 1623 is outputted from the edge enhancement filter control section 1610, and, thereby, the edge enhancement filter tap coefficient 1625 is outputted to the edge enhancement filter 1506 from a filter table. These control is controlled by the control circuit 1604 which makes information the quantization parameter control signal 1618 and the timing signal 1619. As for this example, the line memory 1613 is given to the line memory 1612 and the edge enhancement filter 1506 like a case of drawing 12 at the median filter 1605, respectively. Since it applies to the output terminal 1603 from the input terminal 1601 since a memory is individually given to each filter, and it has a memory individually while little filtering processing of delay is possible, the feature of this example is at a point that circuit structure becomes large.

[0046]On the other hand, one embodiment of the circuit which unified the memory is drawing 17. this image-filters equipment 1708 -- decoding -- **** -- with the input terminal 1701 and the quantization parameter input terminal 1702. It has the processing generating picture terminal 1703, the filter control part 1704, the median filter 1705, the edge enhancement filter circuit 1706, the edge enhancement filter control section 1709, the timing signal input terminal 1711, the line memory 1715, and the memory control section 1716. The decoded image signal 1717 inputted into the decoded image input terminal 1701 is first inputted into the median filter 1705, and noise rejection processing of block distortion etc. is performed to it. The timing signal 1719 is inputted into the timing signal input terminal 1711, and the quantization parameter signal 1718 is inputted into the quantization parameter input terminal 1702. An edge enhancement filter control section controls an edge enhancement filter by the quantization parameter signal 1718.

[0047]The median filter 1705 operates in this example, referring to not a control section but a quantization parameter value directly, and about the edge enhancement filter 1706. It has composition which has a filter table in an edge enhancement filter circuit, optimal filtering processing is performed by the control signal 1723, and the output image signal 1722 is outputted. In this circuit, since the line memory 1715 is shared, complicated processing is required of managements of a memory, such as timing control. These processings are performed by the memory control section 1716.

[0048]In that a memory was unified, although a circuit of this embodiment is the same as that of drawing 13, In a circuit of drawing 14, in order that a filter may be a series connection in this

example and two filters may operate simultaneously to being always one, time to access a memory cuts in twice a filter which accesses a memory since one of two filters is chosen. Therefore, delay from the input terminal 1701 to the output terminal 1703 becomes very large, and while an increase in a delay value by this memory unification will become more remarkable compared with a case of drawing 14, it can reduce circuit structure.

[0049]Although invention made by this invention person above was concretely explained based on an embodiment, it cannot be overemphasized that it can change variously in the range which this invention is not limited to the above-mentioned embodiment, and does not deviate from the summary.

[0050]

[Effect of the Invention]Since an operation of the low pass filter to a portion with high quantization precision is lost in order to control a filter based on quantization information when filtering to the decoded image according to this invention, as explained above, A low pass filter cannot act on the portion in which block distortion does not exist, but a low pass filter can be made to act on the portion in which block distortion exists. Since the appearance of block distortion or a mosquito noise can be predicted from quantization information, it becomes possible to make an edge enhancement filter act to the portion into which a noise does not appear. The edge enhancement which controlled the noise becomes possible from the above thing, and the improvement of large image quality can be aimed at.

TECHNICAL FIELD

[Field of the Invention]This invention is applied to the decoding device of the picture signal compressed by image coding systems, such as MPEG, and relates to effective technology.

PRIOR ART

[Description of the Prior Art]In the conventional image decoding device, in order to reduce the noise contained in an outputted image, it is common to use a low pass filter. For example, in image coding systems, such as MPEG, when a motion of a picture is large, encoding efficiency gets worse. For this reason, in order to reduce the code amount to generate and to quantize roughly at the time of coding, In order that the thing which is a unit of coding as a result and which distortion generates for every block may reduce the image deterioration by this block distortion that often exists (it is called block distortion below.), When the movement quantity of an image is large, a low pass filter is applied to a decoded image, and the technique of removing such block distortion is generally known well.

[0003]

EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, when filtering [this invention] to the decoded image, in order to control a filter based on quantization information, an operation of the low pass filter to a portion with high quantization precision is lost.
Therefore, a low pass filter cannot act on the portion in which block distortion does not exist, but a low pass filter can be made to act on the portion in which block distortion exists.
Since the appearance of block distortion or a mosquito noise can be predicted from quantization information, it becomes possible to make an edge enhancement filter act to the portion into which a noise does not appear. The edge enhancement which controlled the noise becomes possible from the above thing, and the improvement of large image quality can be aimed at.

TECHNICAL PROBLEM

[Problem to be solved by the invention]In the removing method of the block distortion by the conventional low pass filter, since the low pass filter is applied per image frame, a low pass filter will be applied also to the portion which block distortion has not generated, and there is a problem that the whole picture fades.
[0004]Since it generates [block distortion] in many cases when the quantization precision at the time of coding is low, if quantization precision is high, even if movement quantity is large, it will become difficult to generate block distortion. However, in the block distortion removing method by the low pass filter which is conventional method, since only the motion information which is difference information with a front picture is referred to, also when the quantization precision at the time of coding is high, a low pass filter is applied and there is a problem that the whole picture fades.
[0005]Since recognition of the picture as which the outline is generally emphasized "is made into a good picture" rather than the picture from which the outline fell is carried out, it needs to emphasize an outline in a picture. However, in conventional method, in order to apply the low pass filter for removing block distortion, while the contour part of a picture is also referred to as fading simultaneously, there is a title.
[0006]The purpose of this invention prevents the outline of a picture from fading while reducing the block distortion generated when a large quantization step is taken, in order to reduce a code amount to the big picture of a motion, and it provides the image decoding device which can raise display image quality. About the other purposes and the new feature, it will become clear from description and the accompanying drawing of this Description along [said] this invention.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the theoretic composition of the image decoding device of this invention.

[Drawing 2]It is a block diagram showing the embodiment of the filter device in the image decoding device of drawing 1.

[Drawing 3]It is a block diagram showing other embodiments of the filter device in the image decoding device of drawing 1.

[Drawing 4]It is a block diagram showing the embodiment of the filter device of drawing 2.

[Drawing 5]It is a key map showing an example of a low pass filter.

[Drawing 6]It is a key map showing an example of a highpass filter.

[Drawing 7]It is a key map showing an example of an edge enhancement filter.

[Drawing 8]It is a key map showing an example of a low pass filter with a filter table.

[Drawing 9]It is a key map showing an example of a highpass filter with a filter table.

[Drawing 10]It is a key map showing an example of a median filter.

[Drawing 11]It is a key map showing **** for an example of the area division of the quantization parameter of DCT blocks.

[Drawing 12]It is an explanatory view showing an example of the method of calculation of the normal child-ized value Qav of a filter block.

[Drawing 13]It is an explanatory view showing an example of the detection range of block distortion.

[Drawing 14]It is a block diagram showing the embodiment of the filter device in the picture **** equipment of drawing 1.

[Drawing 15]It is a block diagram showing other embodiments of the filter device in the picture **** equipment of drawing 1.

[Drawing 16]It is a block diagram showing other embodiments of the filter device of drawing 2.

[Drawing 17]It is a block diagram showing other embodiments of the filter device of drawing 2.

[Explanations of letters or numerals]

101 Decoded image input terminal
102 Quantization parameter input terminal
103 Processing generating picture terminal
108,208,308,408 Image enhancement filter device
309 The filter table of an edge enhancement filter
310 The filter table of a low pass filter
406 Edge enhancement filter circuit
408 Image enhancement filter device
501 Delay circuit
502 Tap coefficient
503 Equalizing processing coefficient

708 Edge enhancement filter circuit
1408-1508, 1608, 1708 image-filters equipment
109 Decoder
1301 Horizontal-blocks boundary detection range
1302 Vertical block boundary detection range
1404-1504, 1604, 1704 filter control parts

MEANS

[Means for solving problem]It will be as follows if the outline of a typical thing is explained among invention indicated in an application concerned. That is, in this invention, filtering using the quantization parameter as a control signal is performed in the latter part of a decoder. That is, the operation of the low pass filter was controlled not using motion information but using the quantization information at the time of coding so that a low pass filter acted only to the portion which block distortion has generated. In order to emphasize the contour part of an inputted image to the portion in which block distortion does not exist, the filter (the following, edge enhancement filter) which emphasizes a contour part is made to act.
[0008]It is made to act on an image by providing a low pass filter and an edge enhancement filter in the outputting part of a decoded image, and changing suitably this low pass filter and edge enhancement filter as these concrete realization techniques, using the quantization information at the time of coding.
[0009]As composition into which this technique was developed, using the block distortion removal filter by quantization information, etc., before performing edge enhancement, block distortion is removed, it is making an edge enhancement filter act over the whole picture after that, and edge enhancement which controlled the noise is performed.
[0010]
[Mode for carrying out the invention]Hereafter, the suitable embodiment of this invention is described based on Drawings. Drawing 1 is one embodiment **** of the image decoding device of this invention. The image-filters equipment 108 of this example The decoded image input terminal 101, It comprises the quantization parameter input terminal 102, the processing generating picture terminal 103, the control device 104, the low pass filter 105, the edge enhancement filter 106, and the selection circuitry 107, and let the decoded image 117 which the decoder 109 outputted be an inputted image.
[0011]The decoder 109 comprises the variable length decoder (VLD) 110, the inverse quantization device (IQ) 111, and the reverse discrete cosine transform machine (IDCT) 112, with this decoder 109, decoding processing of the input coded image 113 is carried out, and it outputs the decoded image 117. Simultaneously, the table of the quantization parameter used from the inverse quantization device 111 on the occasion of inverse quantization is given to the control circuit 104 as the quantization parameter signal 118. The image-filters equipment 108 of

this embodiment is constituted by the selection circuitry 107 which chooses the picture processed with the low pass filter 105, the edge enhancement filter 106, and one of filters, and the control circuit 104 which controls said selection circuitry 107 based on a quantization parameter value.
[0012]The decoded image signal 117 inputted into the decoded image input terminal 101 is inputted into both the low pass filter 105 and the edge enhancement filter 106. Simultaneously with it, the control circuit 104 the quantization parameter signal 118 of the decoded image to origin. The control signal 121 is sent to the control circuit 107, when a quantization parameter value is large, the low pass filter output signal 119 is chosen, when a quantization parameter value is small, the edge enhancement filter output signal 120 is chosen, and it outputs as the output image signal 122 from the output terminal 103.
[0013]The feature of the image decoding device of this example is in the image-filters equipment 108. Hereafter, this image-filters device part is explained. Drawing 5 is an example of a low pass filter. This low pass filter is a filter of three taps, and it comprises the two delay circuits 501 and product sum operation machines, and the input pixel 504 is inputted into the delay circuit 501, respectively, and is delayed. And to each output of the delay circuit 501, the tap coefficient 502 is made to act, it adds, finally equalizing processing 503 is performed, and the output picture elements 505 are obtained. A low-frequency component is passed by the filter of this example giving twice as many dignity as this to a main pixel value to the next pixel value, and applying one fourth.
[0014]Drawing 6 is an example of the highpass filter which is needed in an edge enhancement filter. Like drawing 5, it is a filter of three taps, and it comprises the two delay circuits 601 and product sum operation machines, and the input pixel 604 is inputted into the delay circuit 601, and is delayed. The tap coefficient value 602 of the filter of this example is taking difference with the next pixel, and passes only a high frequency component.
[0015]Drawing 7 shows the example of composition of the edge enhancement filter 708 using the highpass filter of drawing 6. The edge enhancement filter 708 of this embodiment is realizable by making the highpass filter 706 act to the inputted image 704, adding the outline which is an output with an adding machine to the original inputted image 704 like drawing 7, and obtaining the outputted image 705. In order to realize the edge enhancement filter of this example by three taps like a low pass filter, the tap coefficient 702 is set up like drawing 7. Since this 3 tap edge enhancement filter circuit comprises the delay circuit 701 and the tap coefficient 702 and it is constituted by the sum of the highpass filter which passes the ingredient of the high frequency region of a picture, and the original pixel value, Edge enhancement is realized by making into the output picture elements 705 what added the high pass ingredient to the input pixel 704.
[0016]Drawing 2 shows one of the embodiments of the image-filters equipment in the image decoding device of drawing 1, and this image-filters equipment 208, It comprises the decoded image input terminal 201, the quantization parameter input terminal 202, the processing generating picture terminal 203, the control device 104, the block distortion removal filter 205, the edge enhancement filter 106, and the selection circuitry 107.

[0017]The decoded image signal 217 which the quantization parameter signal 218 inputted into the quantization parameter input terminal 202 was inputted into the control circuit 104, and was inputted from the signal decoded image input terminal 201 is first inputted into the block distortion removal filter 205. A control circuit outputs the selection time control signal 221 with a quantization parameter value, and after choosing either the block distortion removal filter output signal 219 or the decoded image signal 217 by this and emphasizing an outline with the edge enhancement filter 106, it outputs as the output image signal 222.
[0018]In drawing 1, to the low pass filter 205 and the edge enhancement filter 106 having been chosen, before performing edge enhancement by this technique, the cause of the noise is beforehand removed with the block distortion removal filter 205, and in order to perform edge enhancement after that, it becomes possible to always perform edge enhancement. A quantization parameter performs control of the block distortion removal filter 205 and the edge enhancement filter 106 like the case of drawing 1.
[0019]As stated above, in this example, constitute the 1st filter from a one-dimensional low pass filter, and constitute the 2nd filter from a one-dimensional edge enhancement filter, but. It can guess easily from the above-mentioned embodiment that a two-dimensional filter or a noise reducer can use other filters as these filters, and the improvement of image quality can be aimed at by controlling using a quantization parameter value also to those filters.
[0020]The image-filters equipment of drawing 3 is a developed type of the technique of drawing 1, and this image-filters equipment 308, The decoded image input terminal 301, the quantization parameter input terminal 302, and the processing generating picture terminal 303, It comprises the control device 104, the low pass filter 305, the edge enhancement filter 306, the selection circuitry 107, the edge enhancement filter table 309, and the low pass filter table 310.
[0021]This filter table the tap coefficient of the low pass filter 105 with a form as shown by drawing 6 on the low pass filter table 310. It has a tap coefficient of the edge enhancement filter 306 in the edge enhancement filter table 309 every partly, respectively, and it has been the greatest feature to choose the tap coefficient value of each filter with the value of a quantization parameter. The decoded image signal 317 inputted into the input terminal 301 is inputted into the low pass filter 105 and the edge enhancement filter 106.
[0022]The quantization parameter signal 318 is inputted into the control circuit 104 from the quantization parameter input terminal 302. The edge enhancement filter table control signal 323 and the low pass filter table control signal 324 are outputted by this quantization parameter value to the edge enhancement filter table 309 and the low pass filter table 310, respectively. And the edge enhancement filter tap coefficient 325 and the low pass filter tap coefficient 326 are passed to each filter circuit by this control signal. With the selection-circuitry control signal 321 from the control circuit 104, the control circuit 107 chooses one of the low pass filter output signal 319 and the edge enhancement filter output signals 320, and makes it the output image signal 322.
[0023]The example of composition of the filter for changing the tap coefficient value of a low pass filter with a quantization parameter value is shown in drawing 8. The filter of drawing 8 is a lowpass filter circuit of five taps which comprise the delay circuit 801, the tap coefficient

multiplier 802, the equalization coefficient multiplication machine 803, and the filter table 806.
[0024]In this filter, after each delay value of the input pixel signal 804 is processed with a tap coefficient and is finally altogether added with the multiplier 802 formed in each tap, it is equalized with the equalization multiplier 803 and becomes the outputted image 805. Two tap coefficient groups were shown in the filter table 806 as an example. Rather than the case of a left-hand side coefficient group, since the zone of the filter serves as the narrow characteristic, a right-hand side coefficient group passes only the ingredient which is a low frequency wave more. Therefore, it is possible to analyze a quantization parameter value, to choose a right-hand side coefficient, when the appearance of a noise is expected, and to choose a left-hand side coefficient, in being other.
[0025]The embodiment of the highpass filter which is a variable tap coefficient used for an edge enhancement filter is shown in drawing 9. The edge enhancement filter circuit of this embodiment is an edge enhancement filter circuit of five taps which comprise the delay circuit 901, the tap coefficient multiplier 902, the alpha value multiplier 903, and the filter table 906. The zone of right-hand side is narrow and, as for the tap coefficient, the zone has become widely, as for left-hand side as is shown in the filter table 906. Thus, tap numbers can be made variable by making a tap coefficient value variable.
[0026]When the outline of the whole picture is sweet, this filter table 906 is used by the picture by which the outline is solid using the tap coefficient of the left-hand side which extended the zone as the coefficient group on the right-hand side of [narrow] a zone is used. Since adding a contour part to an original image has realized edge enhancement in the method shown in drawing 7, in the embodiment of drawing 9. It is being further taken into consideration how much the contour part which is an output value of not only a tap coefficient value but a highpass filter is added to an original image in analyzing a quantization parameter. It is determined here the outline components of which after the input pixel value 904 is processed by each tap, the multiplication of it is carried out to the alpha value 919 with the multiplier 903, and it puts to an input pixel value. This alpha value is controlled using a quantization parameter.
[0027]The composition of drawing 4 is a developed type of the technique of drawing 2, and this image-filters equipment 408, It has the decoded image input terminal 401, the quantization parameter input terminal 402, the processing generating picture terminal 403, the control device 104, the block distortion removal filter 205, the edge enhancement filter 406, the selection circuitry 107, the edge enhancement filter table 409, and the processing generating picture terminal 403. The decoded image signal 417 inputted from the decoded image input terminal 401 is inputted into the block distortion removal filter 205.
[0028]It can come, simultaneously the quantization parameter signal 418 is inputted into the quantization parameter input terminal 402, and this signal is inputted into the control circuit 104. With the selection-circuitry control signal 421 from this control circuit 104, one of the block distortion removal filter output signal 419 and the decoded image signals 417 is chosen by the selection circuitry 107. Thus, it is possible to make the block distortion removal filter 205 act to the inputted picture, and to make the edge enhancement filter 106 in the latter part act over the

whole picture by removing block distortion etc. beforehand.
[0029]The control signal 423 is outputted and controlled to the filter table 409, the tap coefficient 425 of the edge enhancement filter 406 becomes settled by this, and the control circuit 104 is passed to the edge enhancement filter 406. In this edge enhancement filter 406, after making this tap coefficient 425 act on the inputted picture, it outputs from the processing generating picture terminal 403 as the output image signal 422.
[0030]In the embodiment of drawing 4, although the block distortion removal filter 205 was used, there is a median filter as an example of a filter effective in block distortion removal. The median filter is constituted by the delay circuit 1001 and the comparator 1006 as shown in drawing 10. If the tap numbers of a filter are used as n tap, it will compare [input pixel / 1004] about all the n pixel values, and the pixel value which is the median 1007 will be outputted as the output picture elements 1005. A median filter is a filter from which only a noise component can be removed comparatively efficiently, without dropping the original outline of a picture.
[0031]There are all of the greatest feature of such filter constitution described above in being controlled by a quantization parameter. Although one picture is constituted by the set of the macroblock, this quantization parameter is defined by the macro block unit. As a macroblock is shown in drawing 11, four DCT blocks 1100 in the case of image compression coding gather, and the quantization parameter value is constant at 1106 units of this macroblock. This quantization parameter value has big influence on imaging quality.
[0032]DCT blocks can be divided into the dc component 1101, the low-frequency component 1102, the vertical high frequency component 1103, the horizontal high frequency component 1104, and the high frequency component 1105 as shown, for example in drawing 11. When the value of the quantization parameter of the dc component 1101 is large, in a decoded image, a quantization error becomes large, the luminance value of the whole DCT-blocks field changes per DCT blocks, and block like shape carries out an image, it is recognized, and this serves as block distortion. When the quantization parameter value in the field of the high frequency component 1105 is large, Since the noise called a mosquito comes out in order that distortion may come out to a high region, and also the information on a high frequency component is missing, also becoming a cause which it becomes impossible to express a sharp contour part, and forms block distortion between contiguity blocks is generally known.
[0033]The filter device in this invention performs filtering processing in the unit of the filter block 1107 to the whole picture, when filtering, for example in the whole picture. As an example of how to treat the quantization parameter of the filter block 1107, the quantization parameter value of each pixel contained in the filter block 1107 can be asked by weighting a pixel number like drawing 11. This value Qav is expressed with following formula $Qav=(NL\text{-}NU\text{-}Q1+NR\text{-}NU\text{-}Q2+NL\text{-}ND\text{-}Q3+NR\text{-}ND\text{-}Q4)/t^2$.
[0034]if the technique of this invention is boiled and it depends, it can be guessed whether generating of a noise is predicted with this Qav value by the field on which filtering processing is made to act comparatively easily and correctly. If the value of this Qav is large, a low pass filter will be made to act in the technique of drawing 1, and a block distortion removal filter will be

made to act by the technique of drawing 2. Therefore, edge enhancement is performed without making a low pass filter act and dropping an outline on the macroblock 1106 with a small quantization parameter value, in the macroblock 1106 with a large quantization parameter, a low pass filter acts and reduction of a noise is performed.

[0035]Drawing 13 can be considered as an example of a block distortion removal filter which removes only block distortion. A quantization parameter value changes by a macro block unit. [for this reason, / in the filter block 1107 on which a filter is made to act], Compare the existing quantization parameter value about perpendicularity and a horizontal direction, and The maximum max (Q1, Q3), max (Q2, Q4), max (Q1, Q2), and max (Q3, Q4) are taken, When max (Q1, Q3) or max (Q2, Q4) is larger than a threshold, the low pass filter to a perpendicular direction is made to act, and when max(Q1, Q2) max (Q3, Q4) is larger than a threshold, the low pass filter to a horizontal direction is made to act. In this technique, the horizontal-blocks boundary detection range 1301 and the vertical block boundary detection range 1302 in which the value is variable are set as horizontal and vertical both directions, When the macroblock boundary 1303 does not exist in this range, a block border is not detected but it is made not to make a low pass filter act.

[0036]Drawing 14 and drawing 15 show the composition of one embodiment for a circuit to realize the technique of this invention shown in drawing 1. Drawing 16 and drawing 17 show similarly the example of realization according the technique shown in drawing 2 which is an application of drawing 1 to a circuit as composition.

[0037]An example for realizing drawing 1 is drawing 14. This image-filters equipment 1408 The decoded image input terminal 1401 and the quantization parameter input terminal 1402, The processing generating picture terminal 1403, the filter control part 1404, and the low pass filter 1405, The edge enhancement filter 1406, the selection circuitry 107, and the low pass filter table 1409, The edge enhancement filter table 1410 and the timing input terminal 1411, It comprises the low pass filter control section 1412, the edge enhancement filter control section 1413, the line memory 1414 of a low pass filter, the line memory 1415 of an edge enhancement filter, and the selection-circuitry control section 1416. The line memories 1414 and 1415 are used for preservation of the data for the picture of several lines in the case of filter application. The decoded image signal 1417 is inputted from the input terminal 1401, and is inputted into the low pass filter 1405 and the edge enhancement filter 1406.

[0038]It can come, simultaneously a quantization parameter signal and the 1418 timing signals 1419 are inputted and analyzed from the input terminals 1402 and 1411 to the filter control part 1404. The low pass filter control section 1412 contained in this filter control part 1404, The low pass filter control signal 1424 and the edge enhancement filter control signal 1423 are given to the low pass filter table 1409 and the edge enhancement filter table 1410 by the edge enhancement filter control section 1413, respectively.

[0039]Thereby, the suitable tap coefficient 1426 of a low pass filter and the tap coefficient 1425 of an edge enhancement filter are passed to each filter circuit. The selection circuitry 107 is controlled by the selection-circuitry control signal 1421 from the selection-circuitry control

circuit 1416, either the output of the low pass filter 1405 or the output of the edge enhancement filter 1406 is chosen, and the output image signal 1422 is outputted from the processing generating picture terminal 1403. In this circuit, since the low pass filter 1405 and the edge enhancement filter 1406 have the original memories 1414 and 1415, little operation of delay is comparatively possible.

[0040]On the other hand, it is the image-filters equipment 1508 of drawing 15 which unified the memory using the data bus. This edge enhancement filter circuit The decoded image input terminal 1501 and the quantization parameter input terminal 1502, The processing generating picture terminal 1503, the filter control part 1504, and the low pass filter 1505, The edge enhancement filter circuit 1506, the selection circuitry 107, and the low pass filter table 1509, It has edge enhancement and the filter table 1510, the timing input terminal 1511, the low pass filter control section 1512, the edge enhancement filter control section 1513, the line memory 1514, and the selection-circuitry control section 1516. The decoded image signal 1517 inputted from the input terminal 1501 is inputted into the low pass filter 105 and the edge enhancement filter 106.

[0041]The quantization parameter signal 1518 and the timing signal 1519 are inputted from the input terminals 1502 and 1511 to the filter control part 1504, and it is analyzed in the low pass filter control section 1512 and the edge enhancement filter control section 1513. From these two control sections, the low pass filter table control signal 1524 and the edge enhancement filter table control signal 1523 are given to the low pass filter table 1509 and the edge enhancement filter table 1510. As a result, the optimal low pass filter tap coefficient 1526 and the edge enhancement filter tap coefficient 1525 are given to each filter circuit.

[0042]The selection-circuitry control section 1516 outputs the selection-circuitry control signal 1512, and any one is chosen from two signals by the selection circuitry 107, and it is outputted as the output image signal 1522 from the processing generating picture terminal 1203. In this circuit, the low pass filter 1505 and the edge enhancement filter 1506 are sharing the memory 1514 via a data bus. For this reason, although circuit structure can be made comparatively smaller than the case of drawing 12, control of the whole circuit becomes a little complicated.

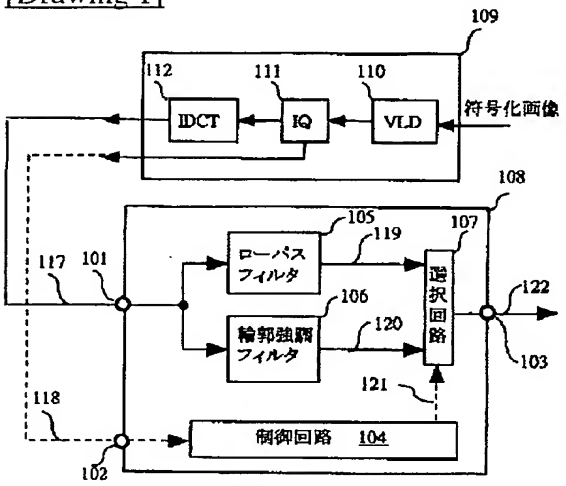
[0043]Next, the example of 1 realization of the circuit of drawing 2 is shown in drawing 16 and drawing 17. In drawing 16, the image-filters equipment 1608, The decoded image input terminal 1601 and the quantization bara meter input terminal 1602, The processing generating picture terminal 1603, the filter control part 1604, and the median filter 1605, The edge enhancement filter circuit 1606 and the edge enhancement filter table 409, It has the median filter control section 1609, the edge enhancement filter control section 1610, the timing input terminal 1611, the line memory 1612, and the line memory 1613, and the median filter 1605 is used as the block distortion removal filter 205.

[0044]The decoded image signal 1617 is inputted into the input terminal 1601 in drawing 16, The image data is inputted into the median filter 1605, and removes block distortion and a mosquito noise beforehand, The edge enhancement filter 206 is made to act after that, it has become circuitry which outputs the output image signal 1622, and a median filter is controlled by

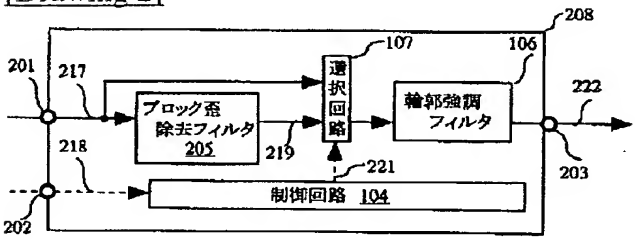
median filter system ****** 1624 from the median filter control section 1609.
[0045]The edge enhancement filter table control signal 1623 is outputted from the edge enhancement filter control section 1610, and, thereby, the edge enhancement filter tap coefficient 1625 is outputted to the edge enhancement filter 1506 from a filter table. These control is controlled by the control circuit 1604 which makes information the quantization parameter control signal 1618 and the timing signal 1619. As for this example, the line memory 1613 is given to the line memory 1612 and the edge enhancement filter 1506 like the case of drawing 12 at the median filter 1605, respectively. Since it applies to the output terminal 1603 from the input terminal 1601 since the memory is individually given to each filter, and it has a memory individually while little filtering processing of delay is possible, the feature of this example is at the point that circuit structure becomes large.
[0046]On the other hand, one embodiment of the circuit which unified the memory is drawing 17. this image-filters equipment 1708 -- decoding -- **** -- with the input terminal 1701 and the quantization parameter input terminal 1702. It has the processing generating picture terminal 1703, the filter control part 1704, the median filter 1705, the edge enhancement filter circuit 1706, the edge enhancement filter control section 1709, the timing signal input terminal 1711, the line memory 1715, and the memory control section 1716. The decoded image signal 1717 inputted into the decoded image input terminal 1701 is first inputted into the median filter 1705, and noise rejection processing of block distortion etc. is performed to it. The timing signal 1719 is inputted into the timing signal input terminal 1711, and the quantization parameter signal 1718 is inputted into the quantization parameter input terminal 1702. An edge enhancement filter control section controls an edge enhancement filter by the quantization parameter signal 1718.
[0047]The median filter 1705 operates in this example, referring to not a control section but a quantization parameter value directly, and about the edge enhancement filter 1706. It has composition which has a filter table in an edge enhancement filter circuit, optimal filtering processing is performed by the control signal 1723, and the output image signal 1722 is outputted. In this circuit, since the line memory 1715 is shared, complicated processing is required of managements of a memory, such as timing control. These processings are performed by the memory control section 1716.
[0048]In that the memory was unified, although the circuit of this embodiment is the same as that of drawing 13, In the circuit of drawing 14, in order that a filter may be a series connection in this example and two filters may operate simultaneously to being always one, time to access a memory cuts in twice the filter which accesses a memory since one of two filters is chosen. Therefore, delay from the input terminal 1701 to the output terminal 1703 becomes very large, and while the increase in the delay value by this memory unification will become more remarkable compared with the case of drawing 14, it can reduce circuit structure.
[0049]Although invention made by this invention person above was concretely explained based on the embodiment, it cannot be overemphasized that it can change variously in the range which this invention is not limited to the above-mentioned embodiment, and does not deviate from the summary.

DRAWINGS

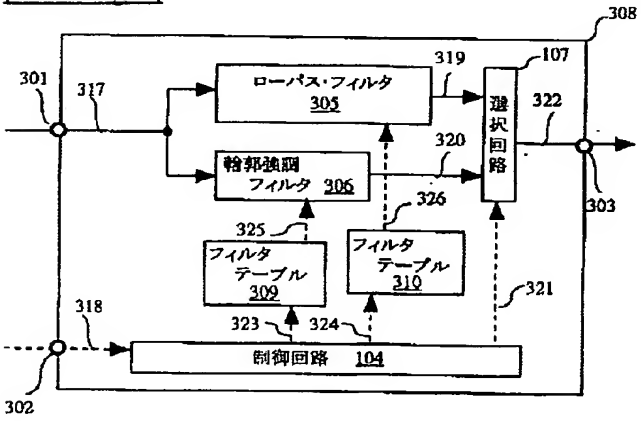
[Drawing 1]



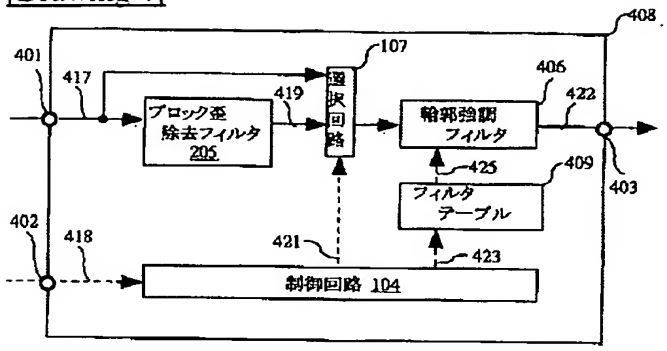
[Drawing 2]



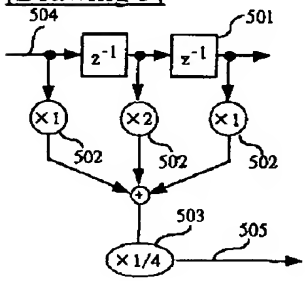
[Drawing 3]



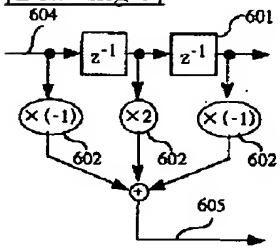
[Drawing 4]



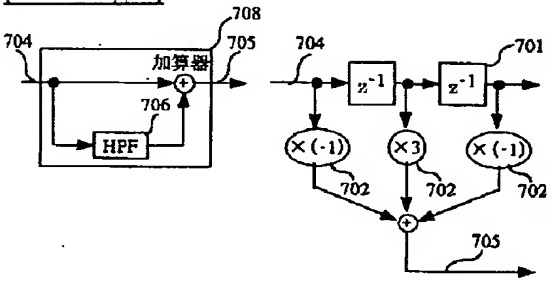
[Drawing 5]



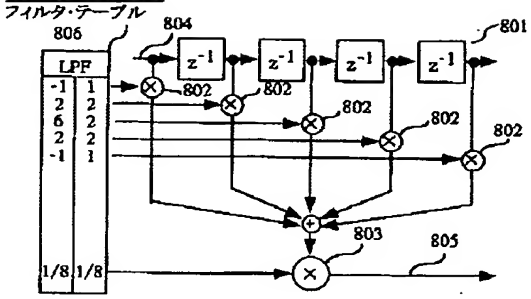
[Drawing 6]



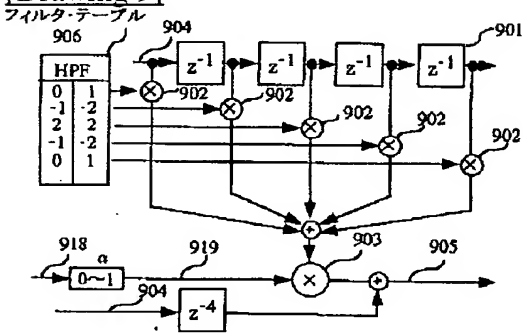
[Drawing 7]



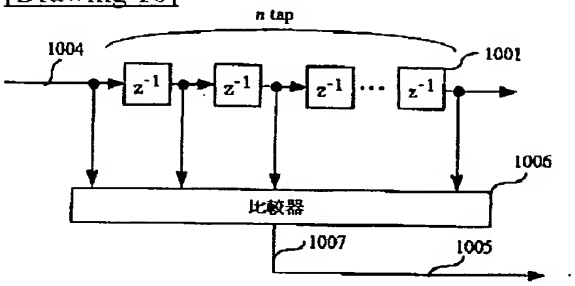
[Drawing 8]



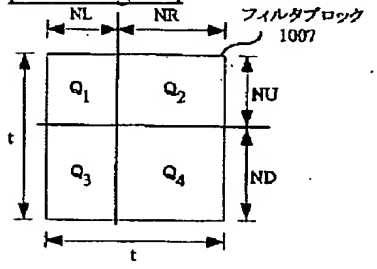
[Drawing 9]



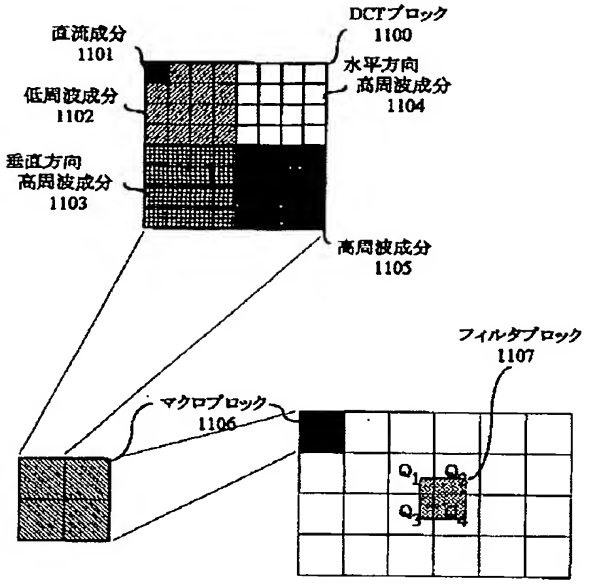
[Drawing 10]



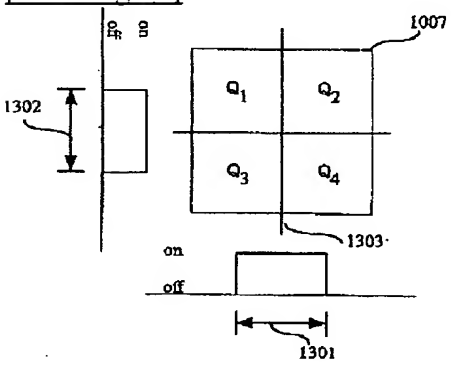
[Drawing 12]



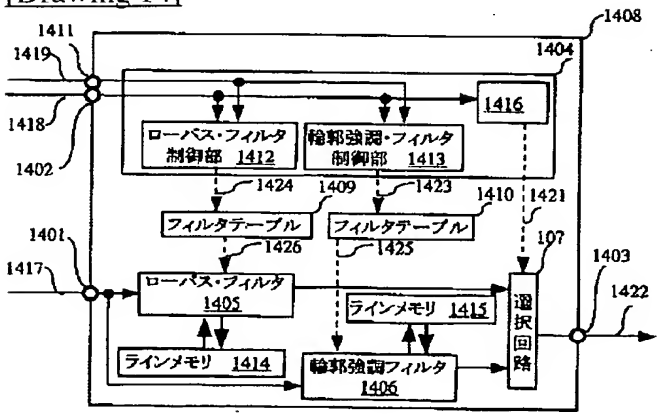
[Drawing 11]



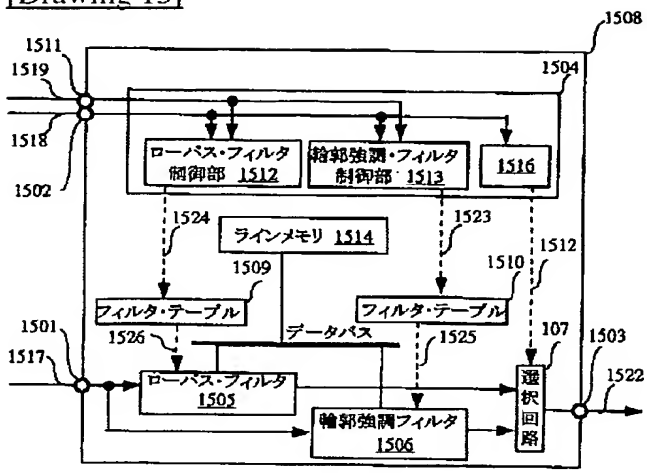
[Drawing 13]



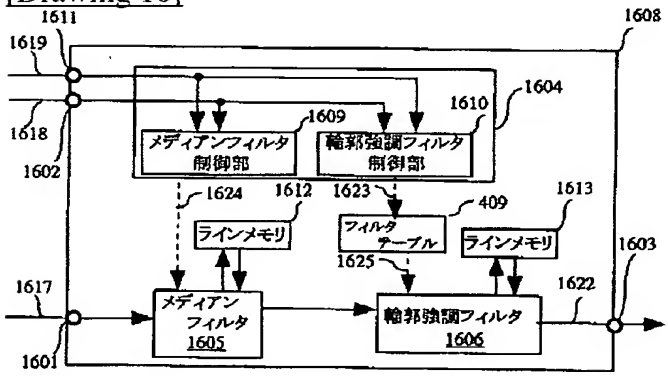
[Drawing 14]



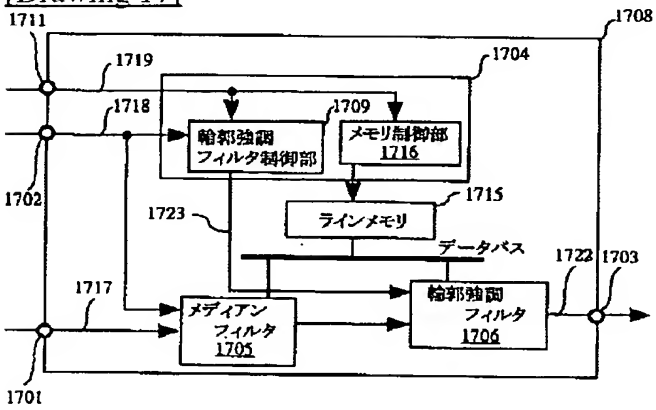
[Drawing 15]



[Drawing 16]



[Drawing 17]



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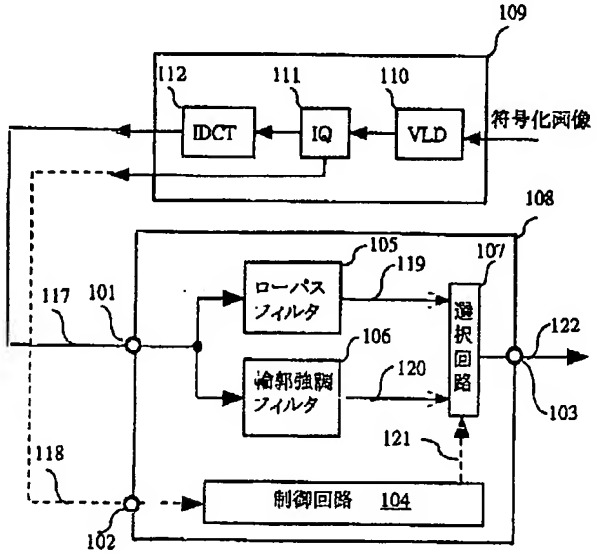
(54)【発明の名称】　画像復号装置

(57)【要約】
【課題】　従来のＭＰＥＧ画像復号装置においては、動き情報をもとにフィルタリングを制御しているため、量子化精度が高くノイズ除去が不要な部分に対してもローパスフィルタを作用させることがある。また、輪郭強調フィルタを用いた場合には、量子化誤差によるブロック歪を助長するため画像劣化を引き起こしてしまうという問題がある。
【解決手段】　符号化時における量子化情報を用いてブロック歪やモスキートの出現を予測し、ローパスフィルタ、輪郭強調フィルタを適宜切り替えて復号画像に作用させることで、出力画像の高品質化を図るようにした。



【特許請求の範囲】
【請求項１】　画像符号化方式により圧縮された画像信号を復号する画像復号装置において、第一のフィルタと第二のフィルタからなり、符号化時に実行された量子化情報に基づいて、上記第一のフィルタ及び第二のフィルタを、復号画像に対して切り替えて作用させることを特徴とする画像復号装置。
【請求項２】　前記第一のフィルタを、ローパスフィルタで構成し、前記第二のフィルタを、画像の輪郭部を強調するフィルタで構成し、前記量子化情報として、ＭＰＥＧ規格の画像符号化におけるＤＣＴ係数を符号化する量子化スケールを用い、量子化スケールがある設定された値よりも大きい場合には前記第一のローパスフィルタを作用させ、また小さい場合には前記第二のフィルタを作用させ、復号画像に発生するブロック歪を軽減しかつ画像の輪郭を強調した復号画像を出力することを特徴とする請求項１の画像復号装置。
【請求項３】　前記第一のフィルタおよび前記第二のフィルタは、各々そのフィルタ係数及びタップ数が可変とされ、量子化情報に基づいてフィルタ係数及びタップ係数が切り替えられることを特徴とする請求項１の画像復号装置。
【請求項４】　前記第一のフィルタとしてブロック歪を除去することを目的としたローパスフィルタあるいはメディアン・フィルタが用いられるとともに、前記第二のフィルタとして輪郭を強調するためのフィルタが用いられ、前記第一のフィルタは符号化時の量子化情報に基づいて作用するか作用しないかが決定され、前記第二のフィルタは、前記第一のフィルタの出力画像に対してフィルタ処理を行なうことを特徴とする請求項１の画像復号装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、ＭＰＥＧ等の画像符号化方式により圧縮された画像信号の復号装置に適用して有効な技術に関する。
【０００２】
【従来の技術】従来の画像復号装置においては、出力画像に含まれるノイズを低減するために、ローパスフィルタを用いるのが一般的である。例えばＭＰＥＧなどの画像符号化方式では、画像の動きが大きい場合には、符号化効率が悪化する。このため発生する符号量を削減するために、符号化時に量子化を荒くするため、その結果符号化の単位であるブロックごとに、歪みが発生することがしばしばある（以下ブロック歪みと呼ぶ。）このブロック歪みによる画像劣化を軽減するために、画像の動き量が大きい場合には、ローパスフィルタを復号画像に適用し、これらのブロック歪みを除去する手法が一般的によく知られている。
【０００３】
【発明が解決しようとする課題】従来のローパスフィルタによるブロック歪みの除去方法では、画像フレーム単位でローパスフィルタを適用しているために、ブロック歪みが発生していない部分についてもローパスフィルタが適用されてしまい、画像全体がボケるという問題がある。
【０００４】また、ブロック歪みは符号化時の量子化精度が低い場合に発生することが多いため、量子化精度が高ければ、動き量が大きくてもブロック歪みは発生しにくくなる。しかし、従来手法であるローパスフィルタによるブロック歪み除去方法では、前の画像との差分情報である動き情報のみを参照しているために、符号化時の量子化精度が高い場合にもローパスフィルタを適用してしまい画像全体がボケるという問題がある。
【０００５】また、一般的に輪郭が強調されている画像は、輪郭が落ちた画像よりも「良い画像として」認識されるため、画像内において輪郭を強調する必要がある。しかし、従来手法では、ブロック歪みを除去するためのローパスフィルタを適用するために、画像の輪郭部も同時にボケてしまうという問題がある。
【０００６】本発明の目的は、動きの大きな画像に対して符号量を減らすために量子化ステップを大きくとった場合に発生するブロック歪を低減するとともに画像の輪郭がぼけるのを防止して、表示画質を向上させることができる画像復号装置を提供する。この発明の前記ならびにそのほかの目的と新規な特徴については、本明細書の記述および添付図面から明らかになるであろう。
【０００７】
【課題を解決するための手段】本願において開示される発明のうち代表的なものの概要を説明すれば、下記のとおりである。すなわち、本発明では、復号器の後段において、量子化パラメータを制御信号として用いたフィルタ処理を行なう。つまり、ブロック歪みが発生している部分に対してのみローパスフィルタが作用するように、動き情報ではなく符号化時における量子化情報を用いて、ローパスフィルタの作用を制御するようにした。また、ブロック歪みが存在しない部分に対しては、入力画像の輪郭部を強調するために、輪郭部を強調するフィルタ（以下、輪郭強調フィルタ）を作用させる。
【０００８】これらの具体的な実現手法としては、復号画像の出力部にローパスフィルタと輪郭強調フィルタを設け、符号化時の量子化情報を用いて、このローパスフィルタと輪郭強調フィルタを適宜切り替えることにより、画像に作用させる。
【０００９】また、本手法を発展させた構成としては、量子化情報によるブロック歪み除去フィルタ等を用いて、輪郭強調を行う前にブロック歪みを除去し、その後、輪郭強調フィルタを画像全体にわたって作用させることで、ノイズを抑制した輪郭強調を行う。
【００１０】

【発明の実施の形態】以下、本発明の好適な実施例を図面に基づいて説明する。図１は本発明の画像復号装置の一実施例ある。本実施例の画像フィルタ装置108は、復号画像入力端子101と、量子化パラメータ入力端子102と、処理画像出力端子103と、制御装置104と、ローパスフィルタ105と、輪郭強調フィルタ106と、選択回路107で構成されており、復号器109が出力した復号画像117を入力画像とする。

【００１１】復号器109は、可変長復号器（ＶＬＤ）110と、逆量子化器（ＩＱ）111と、逆離散コサイン変換器（ＩＤＣＴ）112とで構成されており、入力符号化画像113は本復号器109によって復号処理され、復号画像117を出力する。同時に、逆量子化器111から逆量子化の際に使用した量子化パラメータのテーブルを、量子化パラメータ信号118として制御回路104に与える。この実施例の画像フィルタ装置108は、ローパスフィルタ105と、輪郭強調フィルタ106と、いずれかのフィルタで処理された画像を選択する選択回路107と、量子化パラメータ値に基づいて前記選択回路107を制御する制御回路104とによって構成されている。

【００１２】復号画像入力端子101に入力された復号画像信号117は、ローパスフィルタ105と輪郭強調フィルタ106の両方に入力される。それと同時に、制御回路104がその復号画像の量子化パラメータ信号118を元に、制御信号121を制御回路107に送り、量子化パラメータ値が大きい場合にはローパスフィルタ出力信号119を、量子化パラメータ値が小さい場合には輪郭強調フィルタ出力信号120を選択して、出力端子103から出力画像信号122として出力する。

【００１３】本実施例の画像復号装置の特徴は画像フィルタ装置108にある。以下、この画像フィルタ装置部分について説明する。図５はローパスフィルタの一例である。このローパスフィルタは３タップのフィルタとなっており、２個の遅延回路501と積和演算器とで構成されており、入力画素504は遅延回路501にそれぞれ入力され、遅延される。そして、遅延回路501の各出力に対し、タップ係数502を作用させて加算し、最後に平均化処理503を行い出力画素505を得る。本実施例のフィルタは、中心の画素値にその隣の画素値に対して２倍の重みをつけて、1／4をかけることで低周波成分を通過させる。

【００１４】図６は輪郭強調フィルタにおいて必要となるハイパスフィルタの一例である。図５と同様に、３タップのフィルタであり、２個の遅延回路601と積和演算器とで構成されており、入力画素604は遅延回路601に入力されて遅延される。本実施例のフィルタのタップ係数値602は、隣の画素との差分をとることで、高周波成分のみを通過させる。

【００１５】図７は図６のハイパスフィルタを用いて輪郭強調フィルタ708の構成例を示す。この実施例の輪郭強調フィルタ708は、図７のように、入力画像704に対してハイパスフィルタ706を作用させ、出力である輪郭を本来の入力画像704に、加算器で足し合わせて出力画像705を得ることで実現できる。本実施例の輪郭強調フィルタを、ローパスフィルタと同様に３タップで実現するためには、タップ係数702を図７のように設定する。この３タップ輪郭強調フィルタ回路は、遅延回路701、タップ係数702で構成されており、画像の高周波領域の成分を通過させるハイパスフィルタと、元の画素値の和により構成されているため、入力画素704に高域通過成分を加算したものを出力画素705として、輪郭強調を実現している。

【００１６】図２は図１の画像復号装置における画像フィルタ装置の実施例の一つを示すものであり、この画像フィルタ装置208は、復号画像入力端子201と、量子化パラメータ入力端子202と、処理画像出力端子203と、制御装置104と、ブロック歪み除去フィルタ205と、輪郭強調フィルタ106と、選択回路107で構成されている。

【００１７】量子化パラメータ入力端子202に入力された量子化パラメータ信号218は、制御回路104に入力され、信号復号画像入力端子201より入力された復号画像信号217は、まずブロック歪み除去フィルタ205に入力される。量子化パラメータ値により制御回路が選択回制御信号221を出力し、これによりブロック歪み除去フィルタ出力信号219か復号画像信号217のどちらかが選択され、輪郭強調フィルタ106で輪郭を強調した後、出力画像信号222として出力する。

【００１８】図１ではローパスフィルタ205と輪郭強調フィルタ106が選択されていたのに対し、本手法では輪郭強調を行う前にブロック歪除去フィルタ205で予めノイズの原因を取り除いておき、その後に輪郭強調を行うため、常に輪郭強調を行うことが可能となる。ブロック歪除去フィルタ205と輪郭強調フィルタ106の制御については、図１の場合と同様に、量子化パラメータにより行う。

【００１９】以上に述べたように、本実施例においては、第１のフィルタを１次元ローパスフィルタで構成し、第２のフィルタを１次元輪郭強調フィルタで構成しているが、これらのフィルタとしては２次元フィルタ、あるいはノイズリデューサー等、他のフィルタを使用することが可能であり、それらのフィルタに対しても量子化パラメータ値を用いて制御を行なうことで画質の改善を図れることが、上記実施例から容易に類推できる。

【００２０】図３の画像フィルタ装置は図１の手法の発展型であり、この画像フィルタ装置308は、復号画像入力端子301と、量子化パラメータ入力端子302と、処理画像出力端子303と、制御装置104と、ローパスフィルタ305と、輪郭強調フィルタ306と、選択回路107と、輪郭強調フィルタテーブル309と、ローパスフィルタテーブル310で構成されている。

【００２１】このフィルタテーブルは、図６で示したような形態で、ローパスフィルタ105のタップ係数をローパスフィルタテーブル310に、輪郭強調フィルタ306のタップ係数を輪郭強調フィルタテーブル309にそれぞれいくつかずつ持っており、量子化パラメータの値により各フィルタのタップ係数値を選択することが最大の特徴となっている。入力端子301に入力された復号画像信号317は、ローパスフィルタ105と輪郭強調フィルタ106に入力される。

【００２２】また、量子化パラメータ入力端子302から、量子化パラメータ信号318が制御回路104に入力される。この量子化パラメータ値により輪郭強調フィルタテーブル309と、ローパスフィルタテーブル310に対しそれぞれ、輪郭強調フィルタテーブル制御信号323と、ローパスフィルタテーブル制御信号324が出力される。そして、この制御信号により、輪郭強調フィルタタップ係数325と、ローパスフィルタタップ係数326が、各フィルタ回路に渡される。また、制御回路104からの選択回路制御信号321により、制御回路107はローパスフィルタ出力信号319と、輪郭強調フィルタ出力信号320のどちらかを選択し、出力画像信号322とする。

【００２３】ローパスフィルタのタップ係数値を量子化パラメータ値によって変化させるためのフィルタの構成例を、図８に示す。図８のフィルタは、遅延回路801と、タップ係数乗算器802と、平均化係数乗算器803と、フィルタテーブル806とで構成される５タップのローパスフィルタ回路である。

【００２４】このフィルタにおいては、入力画素信号804の各遅延値が、それぞれのタップに設けられた乗算器802でタップ係数によって処理され、最後に全て加算された後、平均化乗算器803で平均化され、出力画像805となる。フィルタテーブル806には、一例として２つのタップ係数群を示した。右側の係数群は左側の係数群の場合よりも、フィルタの帯域が狭い特性となっているために、より低周波である成分のみを通過させる。従って、量子化パラメータ値を解析し、ノイズの出現が予想される場合には右側の係数を選択し、それ以外の場合には左側の係数を選択する、ということが可能である。

【００２５】また、輪郭強調フィルタに使用する、可変タップ係数であるハイパスフィルタの実施例を、図９に示す。この実施例の輪郭強調フィルタ回路は、遅延回路901と、タップ係数乗算器902と、α値乗算器903と、フィルタテーブル906とで構成される、５タップの輪郭強調フィルタ回路である。タップ係数は、フィルタテーブルに906に示されているように、右側は帯域が狭く、左側は帯域が広くなっている。このように、タップ係数値を可変とすることで、タップ数を可変とすることができる。

【００２６】このフィルタテーブル906は、画像全体の輪郭が甘い時には、帯域を広げた左側のタップ係数を用い、輪郭がしっかりしている画像では、帯域の狭い右側の係数群を用いるというように利用される。図７において示した方法では、原画像に輪郭部を加算することで輪郭強調を実現しているために、図９の実施例では、量子化パラメータを解析することで、タップ係数値のみではなく、ハイパスフィルタの出力値である輪郭部を、どのくらい原画像に足し合わせるかを更に考慮している。入力画素値904は各タップで処理された後、乗算器903でα値919と乗算され、入力画素値に対してどれだけの輪郭成分を乗せるかをここで決定する。尚、このα値は、量子化パラメータを用いて制御される。

【００２７】図４の構成は図２の手法の発展型であり、この画像フィルタ装置408は、復号画像入力端子401と、量子化パラメータ入力端子402と、処理画像出力端子403と、制御装置104と、ブロック歪み除去フィルタ205と、輪郭強調フィルタ406と、選択回路107と、輪郭強調フィルタテーブル409と、処理画像出力端子403を備える。復号画像入力端子401より入力された復号画像信号417は、ブロック歪み除去フィルタ205に入力される。

【００２８】これと同時に、量子化パラメータ入力端子402に量子化パラメータ信号418が入力され、この信号は制御回路104に入力される。この制御回路104からの選択回路制御信号421により、ブロック歪み除去フィルタ出力信号419と、復号画像信号417のどちらかが、選択回路107により選択される。このように、入力した画像に対してブロック歪み除去フィルタ205を作用させておき、ブロック歪み等を予め除去しておくことで、後段にある輪郭強調フィルタ106を画像全体に渡って作用させることが可能である。

【００２９】また、制御回路104は、フィルタテーブル409に制御信号423を出力して制御し、これにより輪郭強調フィルタ406のタップ係数425が定まり、輪郭強調フィルタ406に渡される。この輪郭強調フィルタ406では、入力された画像にこのタップ係数425を作用させた後に、出力画像信号422として処理画像出力端子403より出力する。

【００３０】図４の実施例においては、ブロック歪み除去フィルタ205を用いたが、ブロック歪み除去に有効なフィルタの一例として、メディアン・フィルタがある。図１０に示すように、メディアン・フィルタは、遅延回路1001と比較器1006によって構成されている。フィルタのタップ数をｎタップとすると、入力画素1004について、その画素値ｎ個全てについて比較し、中央値1007である画素値を出力画素1005として出力する。メディアン・フィルタは画像本来の輪郭を落とすことなく、ノイズ成分のみを比較的効率良く除去できるフィルタである。

【００３１】以上に述べた、これらのフィルタ構成の最大の特徴は、全て量子化パラメータによって制御されることにある。画像1フレームはマクロブロックの集合によって構成されているが、この量子化パラメータは、マ

クロブロック単位で定義される。マクロブロックは、図１１に示すように、画像圧縮符号化の際のＤＣＴブロック1100が４つ集まったものであり、このマクロブロック1106単位で量子化パラメータ値は一定である。更に、この量子化パラメータ値は、画像品質に大きな影響を及ぼす。

【００３２】ＤＣＴブロックは、例えば図１１に示すように、直流成分1101、低周波成分1102、垂直方向の高周波成分1103、水平方向の高周波成分1104、高周波成分1105に分けることができる。直流成分1101の量子化パラメータの値が大きい場合には、復号画像において量子化誤差が大きくなり、ＤＣＴブロック単位でＤＣＴブロック領域全体の輝度値が変化し、ブロック状の画像して認識され、これがブロック歪みとなる。また、高周波成分1105の領域にある量子化パラメータ値が大きい場合には、高域に歪みが出るため、モスキートと呼ばれるノイズが出るほか、高周波成分の情報が欠落しているために、鋭い輪郭部を表現できなくなり、隣接ブロックとの間でブロック歪みを形成する原因にもなることが一般的に知られている。

【００３３】本発明におけるフィルタ装置は、例えば画像全体にフィルタリングを行う場合、画像全体に対してフィルタブロック1107の単位でフィルタリング処理を行う。フィルタブロック1107の量子化パラメータの扱い方の一例として、図１１のように、フィルタブロック1107に含まれる各画素の量子化パラメータ値に、画素数を加重することで求めることができる。この値Qavは、次式 $Qav=(NL\ NU\ Q1+NR\ NU\ Q2+\ NL\ ND\ Q3+\ NR\ ND\ Q4)/t^2$ で表される。

【００３４】本発明の手法はによれば、このQav値により、フィルタリング処理を作用させる領域にノイズの発生が予測されるかどうかを、比較的容易かつ正確に推測できる。このQavの値が大きければ、図１の手法においてはローパスフィルタを作用させるし、図２の手法ではブロック歪み除去フィルタを作用させる。したがって、量子化パラメータ値の小さいマクロブロック1106では、ローパスフィルタを作用させて輪郭を落とさずに輪郭強調を行い、量子化パラメータが大きいマクロブロック1106ではローパスフィルタが作用し、ノイズの低減が行われる。

【００３５】また、ブロック歪みのみを除去するブロック歪み除去フィルタの一例として、図１３が考えられる。量子化パラメータ値は、マクロブロック単位で変化する。このため、フィルタを作用させるフィルタブロック1107内において、存在する量子化パラメータ値を垂直、水平方向について比較し、その最大値ｍａｘ（Ｑ１，Ｑ３），ｍａｘ（Ｑ２，Ｑ４），ｍａｘ（Ｑ１，Ｑ２），ｍａｘ（Ｑ３，Ｑ４）をとって、ｍａｘ（Ｑ１，Ｑ３）またはｍａｘ（Ｑ２，Ｑ４）がしきい値よりも大きい場合には垂直方向へのローパスフィルタを作用させ、ｍａｘ（Ｑ１，Ｑ２），ｍａｘ（Ｑ３，Ｑ４）がしきい値よりも大きい場合には水平方向へのローパスフィルタを作用させる。さらに、本手法では、水平、垂直の両方向に、その値が可変である水平ブロック境界検出範囲1301と垂直ブロック境界検出範囲1302が設定されており、この範囲にマクロブロック境界1303が存在しない場合には、ブロック境界を検出せずローパスフィルタを作用させないようにされる。

【００３６】図１４、図１５は図１に示した本発明の手法を、回路により実現するための一実施例の構成を示したものである。また、同様に図１６、図１７は、図１の応用例である図２に示す手法を、回路による実現例を構成として示したものである。

【００３７】図１を実現するための一例が図１４である。この画像フィルタ装置1408は、復号画像入力端子1401と、量子化パラメータ入力端子1402と、処理画像出力端子1403と、フィルタ制御部1404と、ローパスフィルタ1405と、輪郭強調フィルタ1406と、選択回路107と、ローパスフィルタテーブル1409と、輪郭強調フィルタテーブル1410と、タイミング入力端子1411と、ローパスフィルタ制御部1412と、輪郭強調フィルタ制御部1413と、ローパスフィルタのラインメモリ1414と、輪郭強調フィルタのラインメモリ1415と、選択回路制御部1416で構成されている。ラインメモリ1414と1415は、フィルタ適用の際に画像数ライン分のデータの保存のために用いる。復号画像信号1417は入力端子1401より入力され、ローパスフィルタ1405と輪郭強調フィルタ1406に入力される。

【００３８】これと同時に、フィルタ制御部1404に対して、入力端子1402と1411より量子化パラメータ信号と1418タイミング信号1419が入力され解析される。このフィルタ制御部1404に含まれているローパスフィルタ制御部1412と、輪郭強調フィルタ制御部1413によりそれぞれ、ローパスフィルタ制御信号1424と輪郭強調フィルタ制御信号1423が、ローパスフィルタテーブル1409および輪郭強調フィルタテーブル1410に与えられる。

【００３９】これにより、適切なローパスフィルタのタップ係数1426と輪郭強調フィルタのタップ係数1425が、各フィルタ回路へ渡される。また、選択回路制御回路1416からの選択回路制御信号1421により選択回路107を制御して、ローパスフィルタ1405の出力、または輪郭強調フィルタ1406の出力のどちらかが選択され、処理画像出力端子1403より出力画像信号1422が出力される。本回路においては、ローパスフィルタ1405と輪郭強調フィルタ1406が独自のメモリ1414と1415を持っているため、比較的遅延の少ない動作が可能である。

【００４０】これに対してデータバスを用いてメモリを統一したものが、図１５の画像フィルタ装置1508である。この輪郭強調フィルタ回路は、復号画像入力端子1501と、量子化パラメータ入力端子1502と、処理画像出力端子1503と、フィルタ制御部1504と、ローパスフィルタ

1505と、輪郭強調フィルタ回路1506と、選択回路107と、ローパスフィルタテーブル1509と、輪郭強調・フィルタテーブル1510と、タイミング入力端子1511と、ローパスフィルタ制御部1512と、輪郭強調フィルタ制御部1513と、ラインメモリ1514と、選択回路制御部1516を備える。入力端子1501から入力された復号画像信号1517は、ローパスフィルタ105、輪郭強調フィルタ106に入力される。

【００４１】また、フィルタ制御部1504に対して、入力端子1502と1511より量子化パラメータ信号1518とタイミング信号1519が入力され、ローパスフィルタ制御部1512と、輪郭強調フィルタ制御部1513において解析される。この2つの制御部から、ローパスフィルタテーブル制御信号1524と、輪郭強調フィルタテーブル制御信号1523がローパスフィルタテーブル1509と輪郭強調フィルタテーブル1510へ与えられる。その結果、最適なローパスフィルタタップ係数1526と、輪郭強調フィルタタップ係数1525が、各フィルタ回路へ与えられる。

【００４２】また、選択回路制御部1516は選択回路制御信号1512を出力し、選択回路107によって、２個の信号からいずれか1つが選択され、処理画像出力端子1203から出力画像信号1522として出力される。本回路はローパスフィルタ1505と輪郭強調フィルタ1506とが、データバスを介してメモリ1514を共有している。このために、図１２の場合よりも回路規模を比較的小さくできるが、回路全体の制御がやや複雑になる。

【００４３】次に、図2の回路の一実現例を図１６、図１７に示す。図１６において、画像フィルタ装置1608は、復号画像入力端子1601と、量子化パラメータ入力端子1602と、処理画像出力端子1603と、フィルタ制御部1604と、メディアン・フィルタ1605と、輪郭強調フィルタ回路1606と、輪郭強調フィルタテーブル409と、メディアン・フィルタ制御部1609と、輪郭強調フィルタ制御部1610と、タイミング入力端子1611と、ラインメモリ1612と、ラインメモリ1613とを備えてなり、ブロック歪除去フィルタ205としてメディアン・フィルタ1605を用いている。

【００４４】図１６においては、入力端子1601に復号画像信号1617が入力され、その画像データはメディアン・フィルタ1605に入力され、ブロック歪やモスキートノイズを予め除去しておき、その後に輪郭強調フィルタ206を作用させ、出力画像信号1622を出力する回路構成となっており、メディアン・フィルタはメディアン・フィルタ制御部1609からのメディアン・フィルタ制御信号1624により制御される。

【００４５】また、輪郭強調フィルタ制御部1610から輪郭強調フィルタテーブル制御信号1623が出力され、これによりフィルタテーブルから輪郭強調フィルタタップ係数1625が、輪郭強調フィルタ1506に出力される。これらの制御は、量子化パラメータ制御信号1618と、タイミング信号1619を情報とする制御回路1604により制御される。また、本実施例は図１２の場合と同様に、メディアン・フィルタ1605にはラインメモリ1612、輪郭強調フィルタ1506にはラインメモリ1613がそれぞれ与えられている。本実施例の特徴は、それぞれのフィルタにメモリが個別に与えられているために、入力端子1601から出力端子1603にかけて、遅延の少ないフィルタリング処理が可能である反面、メモリを個別に持つために、回路規模が大きくなる点にある。

【００４６】これに対し、メモリを統一した回路の一実施例が図１７である。この画像フィルタ装置1708は、復号画御入力端子1701と、量子化パラメータ入力端子1702と、処理画像出力端子1703と、フィルタ制御部1704と、メディアン・フィルタ1705と、輪郭強調フィルタ回路1706と、輪郭強調フィルタ制御部1709と、タイミング信号入力端子1711と、ラインメモリ1715と、メモリ制御部1716を備える。復号画像入力端子1701に入力された復号画像信号1717は、まずメディアン・フィルタ1705に入力され、ブロック歪等のノイズ除去処理を施される。タイミング信号1719はタイミング信号入力端子1711に、量子化パラメータ信号1718は量子化パラメータ入力端子1702に入力される。輪郭強調フィルタ制御部は、量子化パラメータ信号1718により輪郭強調フィルタを制御する。

【００４７】本実施例では、メディアン・フィルタ1705は制御部ではなく直接量子化パラメータ値を参照しながら動作し、輪郭強調フィルタ1706については、フィルタテーブルを輪郭強調フィルタ回路に持つ構成となっており、制御信号1723により最適なフィルタリング処理が行われ、出力画像信号1722が出力される。また、本回路では、ラインメモリ1715が共有となっているために、タイミング制御等メモリの管理に複雑な処理が要求される。これらの処理は、メモリ制御部1716により行われる。

【００４８】この実施例の回路は、メモリを統一したという点では図１３の回路と同じであるが、図１４の回路では、2つのフィルタのうち1つが選択されるために、メモリにアクセスするフィルタは常に1つであるのに対し、本実施例ではフィルタが直列接続であり、２個のフィルタが同時に動作するために、メモリにアクセスする時間が２倍かかる。従って、入力端子1701から出力端子1703までの遅延が非常に大きくなり、このメモリ統一による遅延値の増加は、図１４の場合と比べてより顕著なものとなる反面、回路規模を削減することができる。

【００４９】以上本発明者によってなされた発明を実施例に基づき具体的に説明したが、本発明は上記実施例に限定されるものではなく、その要旨を逸脱しない範囲で種々変更可能であることはいうまでもない。

【００５０】

【発明の効果】以上説明したように、本発明によれば、復号した画像に対しフィルタリングを行う際に、量子化情報に基づいてフィルタを制御するため、量子化精度が

高い部分へのローパスフィルタの作用がなくなるので、ブロック歪みの存在しない部分にはローパスフィルタが作用せず、ブロック歪みが存在する部分にローパスフィルタを作用させることができる。また、量子化情報からブロック歪みやモスキートノイズの出現を予測することができるため、ノイズの出現しない部分に対しては輪郭強調フィルタを作用させることが可能となる。以上のことから、ノイズを抑制した輪郭強調が可能となり、大幅な画質の改善が図れる。

【図面の簡単な説明】

【図１】本発明の画像復号装置の原理的構成を示すブロック図である。

【図２】図１の画像復号装置におけるフィルタ装置の実施例を示すブロック図である。

【図３】図１の画像復号装置におけるフィルタ装置の他の実施例を示すブロック図である。

【図４】図２のフィルタ装置の実施例を示すブロック図である。

【図５】ローパスフィルタの一例を示す概念図である。

【図６】ハイパスフィルタの一例を示す概念図である。

【図７】輪郭強調フィルタの一例を示す概念図である。

【図８】フィルタテーブルを持つローパスフィルタの一例を示す概念図である。

【図９】フィルタテーブルを持つハイパスフィルタの一例を示す概念図である。

【図１０】メディアン・フィルタの一例を示す概念図である。

【図１１】ＤＣＴブロックの量子化パラメータの領域分割の一例を示すを示す概念図である。

【図１２】フィルタブロックの平均量子化値Qavの算出の仕方の一例を示す説明図である。

【図１３】ブロック歪の検出範囲の一例を示す説明図である。

【図１４】図１の画像復合装置におけるフィルタ装置の実施例を示すブロック図である。

【図１５】図１の画像復合装置におけるフィルタ装置の他の実施例を示すブロック図である。

【図１６】図２のフィルタ装置の他の実施例を示すブロック図である。

【図１７】図２のフィルタ装置の他の実施例を示すブロック図である。

【符号の説明】

１０１　復号画像入力端子

１０２　量子化パラメータ入力端子

１０３　処理画像出力端子

１０８，２０８，３０８，４０８　画像強調フィルタ装置

３０９　輪郭強調フィルタのフィルタテーブル

３１０　ローパスフィルタのフィルタテーブル

４０６　輪郭強調フィルタ回路

４０８　画像強調フィルタ装置

５０１　遅延回路

５０２　タップ係数

５０３　平均化処理係数

７０８　輪郭強調フィルタ回路

１４０８，１５０８，１６０８，１７０８　画像フィルタ装置

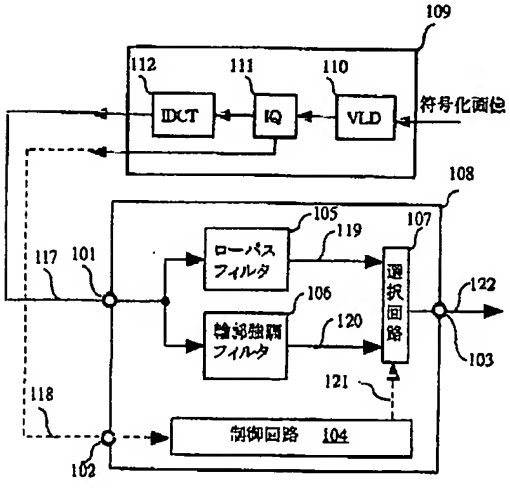
１０９　復号器

１３０１　水平ブロック境界検出範囲

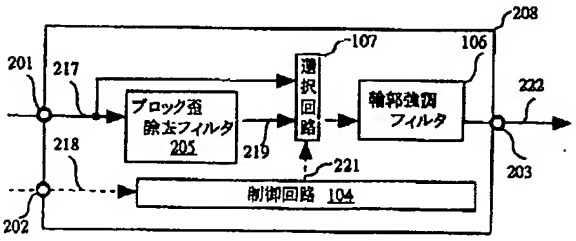
１３０２　垂直ブロック境界検出範囲

１４０４，１５０４，１６０４，１７０４　フィルタ制御部

【図１】



【図２】



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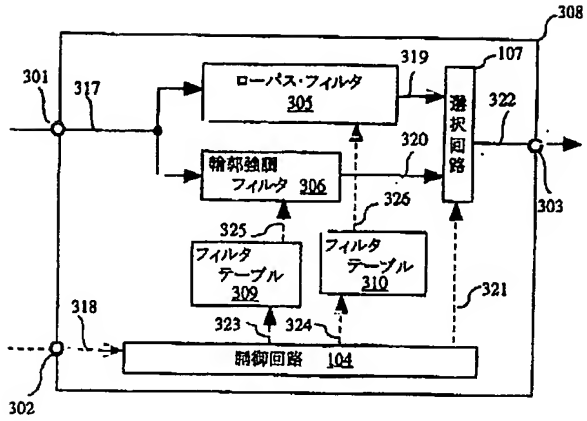

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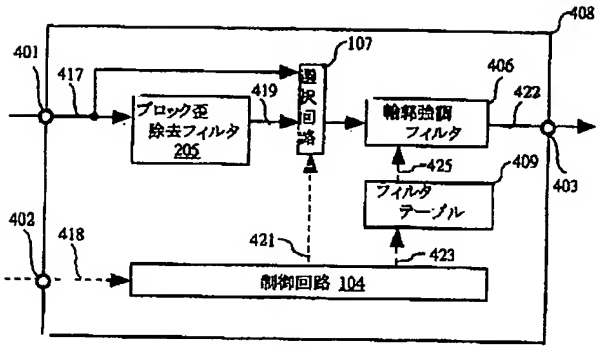

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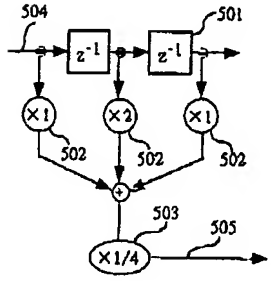

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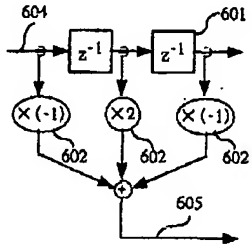

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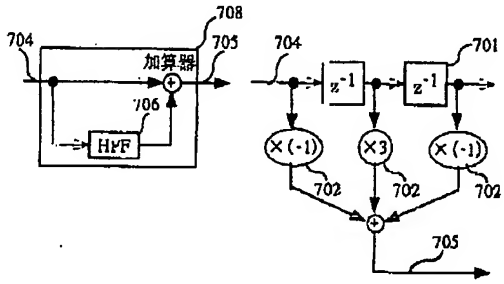

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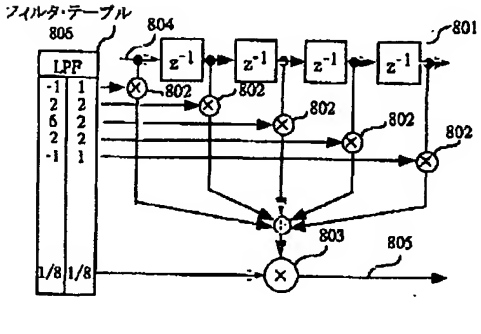

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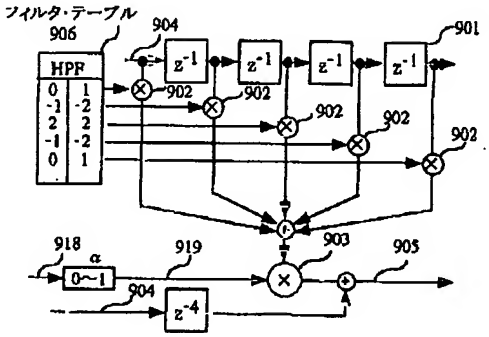

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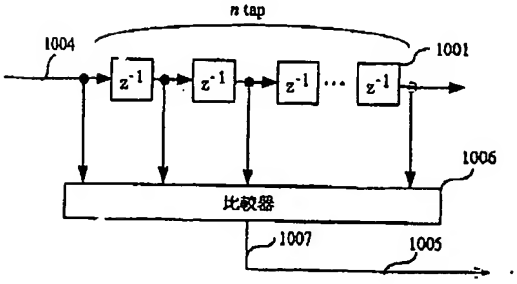

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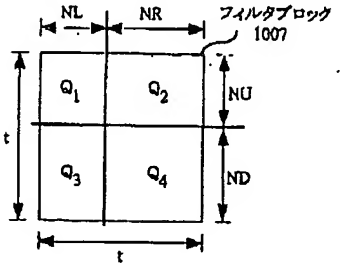

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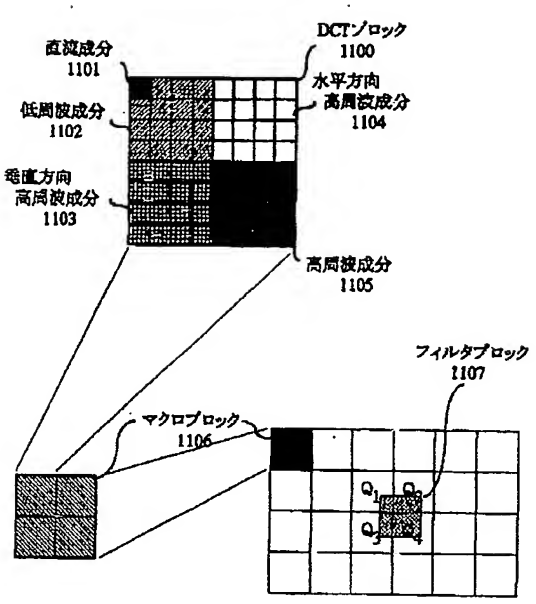

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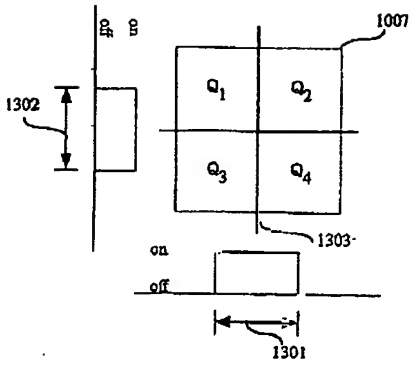

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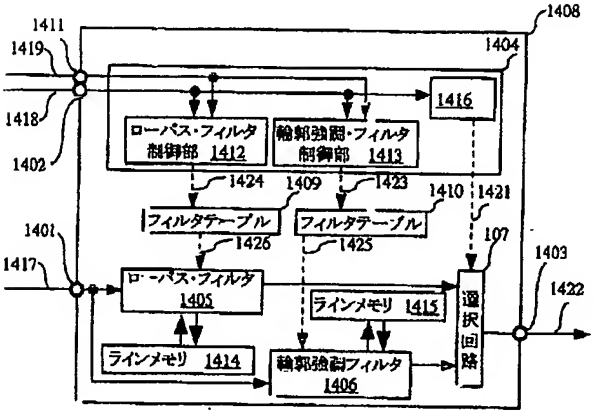

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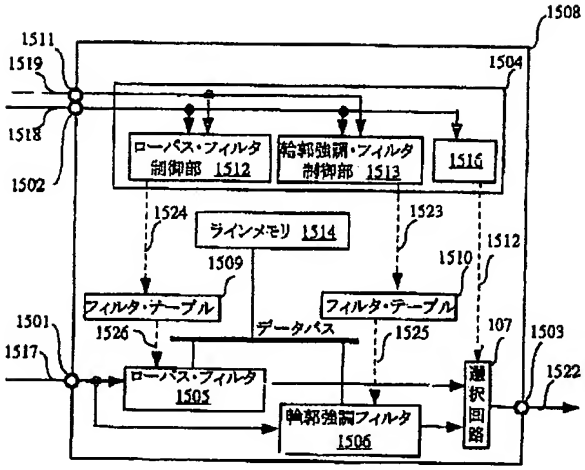

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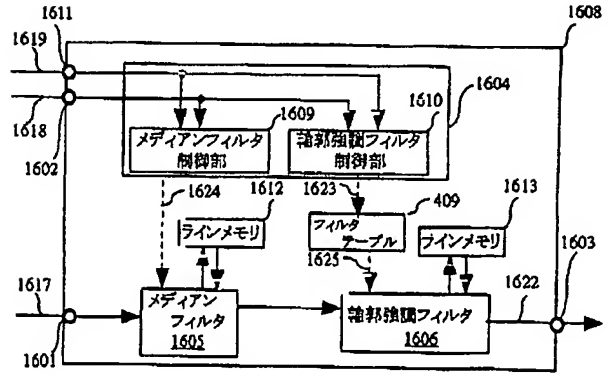

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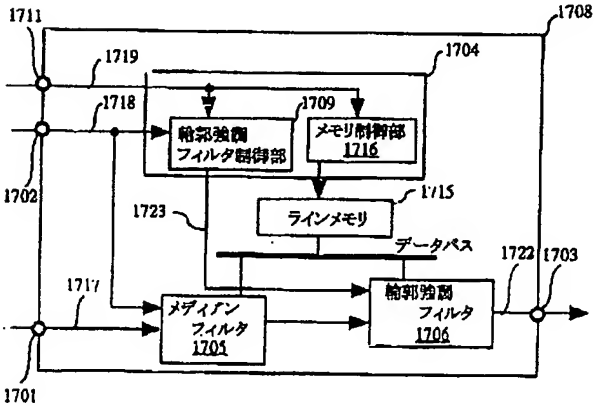

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